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BIRD-SONGS IN AUTUMN.

By Charles A. Witchell.

MANY naturalists of successive generations, from Gilbert White to O. V. Aplin, have noticed the singing of birds in autumn. Mr. Aplin apparently distinguishes a true autumn song as one preceded and followed by a period in which the song is not heard. Some autumnal songs he correctly states to be merely the commencement of the spring songs. "Such are the songs of the thrush, robin, hedge sparrow, and starling." ("The Autumn Song of Birds," *The Zoologist*, 1894, page 410.) In stating that these birds commence in November (or even in October), Mr. Aplin appears not to be accurate, for the robin begins in July, and the wren and starling early in August.

Scientifically considered, the autumn song is chiefly valuable as affording evidence that the singer is not merely obeying an uncontrollable erotic impulse, but is actuated by what may be called higher and more elaborate motives; and it also suggests that these motives may operate at other seasons. There is, however, some difficulty in establishing the occurrence of a true autumn song, for the few birds which seem to render it most clearly in September—chiffchaffs and willow wrens—contrast with the great silent majority of their species. Probably the September singers are not one-twentieth of those which sang incessantly in May. It seems that in different localities the period of song may vary, since Mr. Aplin, in the paper above quoted, mentions the willow wren as becoming silent soon after the middle of June, and striking up again about the second week in August. This may be true of the Oxfordshire birds; but in my present neighbourhood (Bexley, Kent) the willow wren becomes silent in mid-June, but recommences in full strength in the first week of July, and continues till the middle of August; after which only one or two of them will be heard. I have noticed the same incidents in Gloucestershire. My observations on the robin and starling are to the same effect. In a garden at Stroud, where I lived for many years, birds were common throughout the year, except in spring, when the robins retired to the woods to breed, and the starlings led off their broods (in May). Both species returned in the first days of August, and began to sing. They continued in song (except during severe weather) until the time for departure next year; but the starlings shortly before leaving were of course too busy with their broods to do much singing. In Kent the same habits seem to prevail, only the robins begin to sing earlier—by the middle of July. It seems, therefore, rather difficult to identify a true autumn song in either of these species, or in the willow wren. The same remarks apply to the brown wren, which sings loudly at the end of July and early in August. On the other hand, our best warblers, such as the nightingale, blackcap, and garden warbler, are practically never heard in autumn—a fact which Mr. Aplin observed.

It is clear that some birds sing only during the breeding season (*e.g.*, nightingale, redstart, and tree pipit), while others sing on after the close of this period. In attempting to discover the causes of this dissimilarity, we should be careful to remember that the arguments applied to one species may be quite inappropriate to another. The motives inducing song may be quite different in different species. In one, pugnacity—in another, erotism, may prevail. For instance, the robin and thrush seem always to sing before fighting with others of their kind, but not when fighting with birds not of their own race; and in the robin this habit is as constant in autumn as in spring. It would be well, therefore, to analyze each bird's song by ascertaining the meaning of any particular cries it contains, and thus to glean the purport of the whole exclamation. In the case of the lark, the first autumn song is generally a mere repetition of the plaintive call of the young, with other call-notes. It may be objected that this does not constitute a song; but, on the other hand, nothing is more clear than that much of the song of the adult consists of call-notes repeated with some slight variation, or with none at all. In September many larks (probably birds of the year) begin to "peet" and chirrup a good deal as they fly; and they gradually advance in variation during October and November. If the weather be mild during the darker months, they sing throughout the season; but as a spell of cold generally occurs early in December, the birds become silent at that time.

I do not know when the young starling begins to sing, but the old birds undoubtedly resume song in August, and continue to the spring, unless stopped by want of food in the cold season. The only feature distinguishing the autumn songs of the starling and robin from the spring songs, is the absence of the call in the former and the repetition of the call by the latter bird—as already mentioned.* Both birds sing on every fine autumn day,

* "Bird-Songs in Summer," Knowledge, page 157, July *antea*.

quite independently of the presence of their mates. It would therefore seem that when at this season the starling is sitting alone on his favourite chimney, chattering through his accustomed strains, and studying new ones, he is no more conscious of love than is the robin, who, from the top of his highest tree, defies a rival in the next garden. At the same time it is clear that in autumn, as in spring, many song birds, besides the starling, are by no means content with any particular strain, but try to vary their songs as much as possible. In these efforts the birds seem to be influenced by their experience, as we are in other matters. They seem to be influenced by the sounds customary in their environment, and to attune their notes to resemble many of these noises. In the starling this mimicry is excellent. In the robin it is sometimes perfect, but generally obscure and indicated by a similarity in accent and rhythm rather than by identity of tone.

In a general sense the same methods in singing are employed in autumn as in spring; and although some of the first autumn songs are of a simple character (presumably those of young birds), the effort to vary is seemingly as constant in autumn as it is in spring. Despite this, however, the characteristic exclamations and general tone of song are preserved, as though vitally important. Many cries are, doubtless, inherited—especially in birds of limited vocal range; but it is equally certain that in many of the more musical species the songs are traditional—learned by successive generations (probably unconsciously) from their parents, and, in due time, repeated to their successors. It is probable that certain cries may be inherited in a species, and by the same bird song-notes may be acquired by mimicry. In all cases young birds reared under foster parents are more likely to retain the call-notes and alarms than any other notes of their natural parents. Such an autumn singer as the great titmouse, with frequent characteristic alarm-cries, and with song-notes differing considerably in different individuals, yet sometimes exactly resembling those of another species, might illustrate the effects of both heredity and mimicry—the more so because the tits can hardly be termed singers. Unfortunately, the great titmouse is unsuited to the artificial life of a prisoner.

Since there is so little evidence supporting the theory that autumnal songs are love songs, we must attribute them to some other emotional origin. It is clear that spring songs are often addressed by birds to their mates. It is also clear that most of the autumn songs are expressive of pleasure (*e.g.*, those of robin, lark, wren, hedge sparrow, thrush and young blackbird, great tit); and the source of this pleasure may well be the appearance of the surroundings of the singers. It is extraordinary that this statement should be deemed unwarrantable, for many birds have so keen an appreciation of locality that they return year by year, from a long migration, to precisely the same spots; and birds of several resident species will build year after year in exactly the same positions, though each nest and its contents be destroyed by violence. Yet we, who have comparatively so little of the local instinct, are by no means willing to admit that birds may have an æsthetic appreciation of surroundings. We seem to be desirous of limiting these ardent creatures to the operations of unreasoning instinct; and anyone claiming for them a share of some of our higher faculties is met with a chorus of demand for scientific proof—where such proof is obviously unobtainable. One would think that in the case of the robin and starling, at least, no further proof than the manners of the birds when singing could be reasonably required. It is not possible to discuss all the bearings of this question within the limits of one article. The general lines of investigation have, however, been suggested—namely, an analysis of the cries constituting a song, observation of the presence of a mate or other birds, and other general incidents. Each species should be considered separately.

In spring the love-calls of birds are prominent; in summer the cries employed are chiefly addressed to the young; and in autumn the great incident of the southward migration occasions a frequent use of the voice. The cries now employed are call-notes, many of them identical with notes uttered in spring (as in, *e.g.*, finches, pipits, wagtails, swallow, chiffchaff, etc.); and this fact gives weight to the theory that the call-notes are among the most ancient of the cries of birds. These cries are not limited to the hours of daylight; at night the passing migrants may be heard, especially near small country towns, where the illuminations seem to attract the voyagers, and the noise of traffic is not enough to drown their notes.

Most of the aquatic birds migrate at night. Their loud resonant voices are then audible at a considerable distance, and are especially noticeable when heard over inland towns, where the birds themselves may be quite unknown. At Stroud I used to hear at spring and fall the peculiar cries of some migrants passing at night. In spring the sounds were heard between eleven and twelve o'clock, in autumn a couple of hours later. In spring the notes were given at the same pitch by two or three birds; in autumn the sounds were uttered by a half-dozen together, and were in two keys, the higher notes being probably those of young birds. In spring the cries were heard during only a few moments, while the birds were passing; in autumn the noise continued sometimes for minutes, and this suggested that some of the birds (probably the younger ones) had been attracted by the lights in the town or possibly by reflections from the waters of the canal there, and were loth to leave.

The commonest of all night cries of migrants is the soft, brief, whispered "seeyou" of the redwing—sounding rather plaintive and weird in the misty darkness. It is also often heard in the daytime. Throughout November this cry is particularly frequent at night, but it is not very noticeable, and most people do not observe it at all. On one occasion I heard it one hundred and twenty-seven times in the space of an hour and a half; and I have heard it from seventy to ninety times during by no means long walks at night on the Cotteswolds. The sound was heard as plainly on the slopes as on the hilltops—proving that at night the bird flies in the same way as by day, namely, drifting over the land at a height of about a couple of hundred feet. This feature also suggests that we should not ascribe a very lofty flight to all nocturnal migrants because some of them happened to be observed at a vast altitude through the telescopes of astronomers. On the contrary, the frequency with which we hear the signals of these aërial ships passing in the night proves that great numbers of them fly no higher by night than by day.

GREEK VASE PAINTING IN ITALY.

By H. B. Walters, M.A., F.S.A.

In the last volume of Knowledge* a series of articles appeared dealing with the history of ancient Greek vases, more especially those manufactured within the boundaries of Greece proper. We propose in the present paper to deal with an epoch of vase painting which is in many respects distinct from that of Greece

* *See* Knowledge, February, April, July, and December, 1896.

proper, although at the same time it stands in close relation to it. This is the history of vase painting in Italy, as it flourished during a period covered by the fourth, third, and second centuries before Christ, lasting until the Greek civilization in Italy fell under the Roman dominion.

The beginning of this period is marked by the fall of Athens in the year 404 B.C., and the rise of the Macedonian Empire. The extension of Greek luxury and civilization beyond the boundaries of Greece proper and the Ægean Sea, not less than internal causes, brought about the deposition of Athens from her high estate as the centre of Greek literary and artistic activity. Literature found its way to the rising city of Alexandria, which became in this respect a second Athens. Sculpture and painting found a home in Rhodes, Pergamon, and other places on the coast of Asia Minor; and in the same way the humbler art of vase painting was transferred yet further afield, to strike fresh root in the Greek colonies of Southern Italy.

At the same time it must not be supposed that the manufacture of painted vases at Athens came to an abrupt termination with the fall of her supremacy. The series of Panathenaic amphoræ which bear the names of archons, or annual chief magistrates, down to the year B.C. 313, shows that this was not the case. For this survival it may be that religious and ceremonial reasons afford an adequate explanation. But the vases of this period are for the most part of an inferior character, and show such marked signs of decadence that Athens can no longer be regarded as the centre of the industry.

It seems probable that there was at this time a migration of Athenian craftsmen, not only to Southern Italy—where many vases have been found which are painted in a style free from local influences, yet showing a marked inferiority to the products of the preceding century—but also to other provincial centres of Greek life. At Kertch, in Southern Russia (the ancient Panticapæum), a vase has been found, dating about 400 B.C., with the signature of one Xenophantos, who expressly calls himself an Athenian. A trade connection between Athens and Panticapæum is well attested by some of the private orations of Demosthenes. Another site where numerous Athenian vases of the same character have been found is the district of North Africa known as the Cyrenaica. Isolated specimens have also been found at various places in the Eastern Mediterranean.

In Southern Italy Greek art had lighted on a very favourable soil. The great colonies, such as Tarentum, Capua, and Pæstum—founded almost in the dawn of Greek history—were not only as completely Hellenic as Athens or Corinth, but in luxury and splendour even surpassed the chief cities of Greece proper. Hence art flourished in these towns far more readily than in the distant and comparatively barbarous regions of Southern Russia and Northern Africa. In the character of their productions we see the nature and condition of the inhabitants of Southern Italy reflected. The chief thing aimed at is splendour and general effect, and both in the size and colouring of the vases—especially in those found in Apulia—we are enabled to gather some idea of the magnificence and luxury in which the people lived. These fabrics fall mainly into three classes, known as Apulian, Campanian, and Lucanian, each displaying individualities of style and method which will be noticed later. We have also indicated that there are many vases which must be classed along with these, although the products of emigrant Athenians rather than of home-bred artists.

The principal centre of Greek civilization in Magna Græcia was Tarentum, which reached its greatest height of prosperity under Archytas (B.C. 400-365); its supremacy was generally recognized by the rest of Southern Italy. Rich and prosperous as it was, and with an admirable geographical position, Tarentum became the chief emporium of that part of the world, and among other industries that of pottery can hardly have been found wanting. It is further probable that the Tarentine vase painters were the first to adopt the methods and conceptions of Athenian artists, establishing a local fabric in popular favour. However, few vases have actually been found there, while many have come to light at Ruvo, Bari, and other places in the neighbouring Apulia; while at Ruvo actual remains of a pottery and furnace have been discovered, so that it is very likely that that place was for some time the headquarters of the Apulian fabric.

In Campania the chief seat of vase manufacture is supposed to have been Cumæ, but Nola and Capua both dispute its rivalry; while in Lucania most vases have been found at Anzi and Pæstum. Local characteristics, such as details of costume or armour, are of importance in the history of these vases, and show that the Athenian influence was being supplanted by a purely Italian conception and method of treatment.

Fig. 1.—Bell-shaped Krater (Mixing Bowl), with scene from a farce: a father dragging a drunken son home from a symposium. The actual stage is represented. Fourth century B.C.

The manufacture of vases in Southern Italy appears to have been carried on to some extent down to the first century B.C.; but it is probable that the wars of Pyrrhus and Hannibal—when towns like Tarentum and Capua suffered considerably and were almost completely Romanized—had the effect of corrupting, if not destroying, a purely Greek taste. As the whole of Southern Italy gradually fell under the dominion of Rome in the third and second centuries B.C., the Roman influence becomes more and more apparent, in the way of inscriptions or even subjects. Some vases, moreover, strongly recall the Pompeiian wall paintings of the second century in their

method of decoration (*see* Fig. 4). Finally, pottery is only represented by the so-called Samian or Aretine fabrics, which do not come within the scope of our present subject.

We have treated the subject from the historical point of view at considerable length, but it was necessary to do this in order to throw light on the various phases through which Greek vase painting passed to its final extinction. We now turn to the discussion of the chief characteristics of the vases of this period.

There are certain common features which all may be said to display. There is throughout a perpetual striving after effect rather than beauty, either in the actual size of the vases—in largeness of style and bold drawing—or by means of gaudy colouring, or, in the latest examples, by variety and exaggeration of shape. Common to all alike is the fondness for ornamental patterns, such as laurel or ivy wreaths, mæander, and palmettes; but every shape of vase has its characteristic decoration. The shapes present a very great variety compared with the last period; the most consistently popular is the bell-shaped krater (mixing bowl) with small side handles. Another variety of the krater is of great size, with very elaborate handles and a profusion of decoration; while another, which is peculiar to Lucania, has four handles, two vertical and two horizontal. Many of the amphoræ are also of gigantic size and highly decorated. The Athenian kylix disappears entirely and its place is taken by the phiale, a large shallow bowl, which was probably intended for hanging up against the wall, and found favour in the houses of the rich as a means of internal decoration. We have two new varieties of vases for holding sweetmeats, consisting of jars and dishes with covers. The drinking vessels and oil flasks show great variety of form, especially in the later examples, one popular form being the rhyton, a drinking-horn ending in the head of an animal.

Fig. 2.—Krater (Mixing Bowl), of Apulian fabric, made for use in funeral ceremonies, with scene representing two mourners bringing offerings to the tomb, in front of which is a statue of the dead man. About 300 B.C.

As regards the method of decoration, it is, generally speaking, that of the last period, with red figures on black ground; but all ideas of simplicity and refinement are lost, and the same tendency to exaggeration and showiness is seen in the choice of colours as in the drawing. In many vases, even of the better style, large masses of white are laid on. Yellow is also largely used for enhancing details, and purple is not uncommon. Occasionally attempts are made at shading. The figures on the reverse of vases with double subjects are always drawn and painted with great carelessness, as if they were not intended to be much seen. The drawing is entirely free, and, in fact, errs on the other side, as it tends to become careless and faulty; the forms are soft, and the male figures often effeminate. Extreme facility of hand has become the ruin of the artist. Moreover, a love of the far-fetched betrays itself in variety of posture and elaborate foreshortening; while fanciful and richly embroidered draperies recall theatrical costumes, and must often have been copied from them. Frequent attempts are made at perspective, but they are seldom successful. As a rule, the artist is content to indicate figures in the background by placing them on a higher level, or only showing the upper half of them. Landscape is represented by rocks and flowers scattered about, trees, and buildings; but in most cases the painter prefers merely to give a clue to the scene by objects suspended in the air.

It is probable that the artists of this period were largely influenced by the great Greek painters of the fifth and fourth centuries. The effect of many of the scenes on the larger vases is distinctly pictorial, and the subjects in many cases lead our thoughts directly back to themes which we know to have been employed by Zeuxis and other great masters. In the British Museum collection is a vase with the subject of the infant Herakles strangling the snakes, which corresponds closely with Pliny's description of a picture of Zeuxis; and another represents the death of Hippolytos much as described by a writer named Philostratos in reference to a picture in a gallery at Naples. Again, in the latest vases we are often reminded of the fresco paintings characteristic of the Hellenistic age, of which the wall decorations at Pompeii give us a very fair idea.

Another influence at work was that of the stage, in which both tragedy and comedy play their part. The influence of tragedy, as represented on the Greek stage, is seen not only in the choice of subjects, but in the composition of the scenes and the costumes of the figures. The architectural arrangements of some scenes, with a temple, altar, or statue in the centre, the elaborately embroidered draperies, and the abundance of dramatic action, can only be due to the influence of the stage. It is to Euripides that this is chiefly to be ascribed, as there appears to have been a great revival of his plays about the beginning of the third century in Magna Græcia; moreover, the tendency of the age to passion and pathos, as seen in such sculptures as the Laocoon group, would naturally find an echo in the

subjects treated of by Euripides, who was considered by Aristotle "the most tragic of poets." The influence of comedy is of another kind. Here we have no traces of any revival of Aristophanes and his contemporaries, whose plays were too essentially topical to be adapted for such a purpose; nor, again, of the new comedy of Menander, which was purely a comedy of manners. The influence

Fig. 3.—Situla (Bucket), of Apulian fabric, with scene representing Dionysos espousing Ariadne. The stand is modern. About 300 B.C.

here is peculiarly local, and is derived from a kind of farce which was popular in Southern Italy and Sicily, and which either dealt with subjects of daily life or with burlesques of mythology. In many of these comic scenes as pourtrayed on the vases, the actual stage is represented (*see* Fig. 1); in others we have merely the figure of a comic actor dancing or otherwise. The costumes are closely related to those of the Aristophanic comedy; the figures wear grotesque masks and have padded stomachs and tight trousers. On many vases of this period on which scenes from mythology are represented, although the theme is essentially tragic, yet the treatment of the subject has to our eyes a distinctly grotesque or even comic effect. This appears to be quite unintentional, and is supposed to be due to certain elements of exaggeration attending the revival of tragedy in Southern Italy.

The influence of the drama on the vases seems to have supplanted almost entirely the old heroic myths that were at one time so popular, and to have directed the artists rather to seek opportunities for the rendering of human passion. Hence the most popular subjects are now such as the story of "Thebes or Pelops' line or the tale of Troy divine." Subjects from daily life are equally common, such as banquet scenes, the game of cottabos, athletes in the gymnasium, or what are known as "toilet scenes." The commonest subject of all is that of a youth and girl exchanging presents, such as fruit, sashes, or toilet-boxes; probably these are intended for scenes of courting (as Fig. 3), but as a rule they are merely fanciful, and are parallel to the figures represented on Dresden china and other modern works of art. A peculiar feature of this period is the almost universal presence of Eros, the god of love, whatever the character of the subject.

Two classes of subjects to which we have not yet alluded have an important bearing on the purpose for which these vases were manufactured, namely, for use at funerals (*see* Fig. 2). The first class represents scenes in the nether world, and consists generally of a central group of Pluto and Persephone seated in a building, surrounded by such figures as Orpheus and Eurydice, Herakles with Cerberus, Tantalos, Sisyphos, and Ixion. The second is confined to scenes representing offerings at the tomb of the departed, which generally takes the form of a shrine or small temple, at which the relatives offer libations or meet to mourn, as on the Athenian lekythi described in the last article. It is natural to suppose that these scenes represent the worship of a deified ancestor of the family, such as is known to have been a universal custom among the Greeks.

Fig. 4.—Phiale (Saucer), painted with a figure of Ganymede, in the style of a fresco painting, with light and shade effects. Second century B.C.

Artists' signatures are very rare on vases of this period, and only three are known by name: Assteas, Python, and Lasimos. The two latter only occur once, the British Museum possessing a very fine specimen of Python's work, with an interesting subject—the deliverance of Alcmena from the wrath of her husband Amphitryon by Zeus, who sends rain to quench the fire on which she was to be burnt. The style of Assteas and Python is very similar, and both appear to have been resident at Pæstum.

Fig. 5.—Hydria, of Tarentine fabric, with painting in opaque white on black ground. About 200 B.C.

With the vases of Southern Italy we must group a small class of specimens of Etruscan art. These vases are undoubted imitations of Greek fabrics imported into Etruria, and

it is only necessary to regard them side by side with specimens of good Greek work to see how wide the gulf is that separates them. Etruscan art has certain characteristics that infallibly distinguish it from Greek, and demonstrate the utter baselessness of the notion that what we now recognize as vases of Greek manufacture can ever have been produced in Etruria. The drawing is either over-elaborated and full of stiff mannerisms, or else helpless and ugly, while the style is altogether dry and lifeless. Moreover, the execution is manifestly inferior even to the Græco-Italian vases, with imperfect black glaze and dull yellow clay. In point of date these vases belong to the second and third centuries B.C. Greek mythological subjects are popular, but local deities are also introduced, such as Charun, the Lasas, and other conceptions of Etruscan religious belief. On several of these vases inscriptions in the Etruscan alphabet are found.

FIG. 6.—Lekythos (Oil Flask), ornamented with figures in relief, representing Ajax seizing Kassandra. Third century B.C.

Some vases of this period are archaistic in character—that is to say, they are deliberate imitations of primitive or black-figured fabrics. Others illustrate the tendency of the period to strive after new effects, either by new methods of painting or by the addition of reliefs (as on Fig. 6) or stamped patterns, or, again, are moulded into the forms of human beings and animals. In the direction of a new style of painting, the most important is a group of vases found chiefly in the neighbourhood of Tarentum and Egnazia, and occasionally in the Greek islands (*see* Fig. 5). The whole vase is covered with a black glaze, on which a white pigment is applied, the effect being enhanced by details in purple and yellow. The tendency is to reduce the labour of painting to a minimum, and the subjects are generally confined to the upper part of the vase and limited to simple decorative motives, such as a bird or a mask.

Vases with reliefs or moulded into various forms are not exclusively characteristic of this period, as many such belong to the finest stages of Greek ceramic art, or even to a more primitive phase; but in the third and second centuries their number becomes much larger in proportion to the painted vases. Nor are they found only in Italy, as numerous examples occur all over Greece down to comparatively late times. Many of these vases are imitations of metal, and appear to be copies of popular works in silver and bronze, made for those who could not afford the more expensive material. This is especially the case with a series of bowls, found chiefly in Greece, which have figures in relief on the outside, the subjects being often taken from the Homeric poems or the plays of Euripides. We read in Suetonius that the Emperor Nero possessed "Homeric bowls" of silver, which were probably decorated in this fashion. These bowls may be regarded as the prototypes of the Aretine bowls which become so common in the Roman period. Many of these vases with reliefs actually bear the names of Roman potters, and a small class of cups with simple painted decoration have early Latin inscriptions painted on them, with dedications to various deities.

THE PRIME MOVERS OF NERVE AND MUSCLE.*

AMONG the wonderful phenomena which this little world of ours presents to the inquiring mind, that which constitutes the distinctive feature of animated nature—activity in all its forms—appeals to our admiration most forcibly, and it loses none of its interest when intellectually considered. If evidence were required to establish the veracity of such a statement we should find it in Sir William Gower's little book—"The Dynamics of Life."

Search as we may, that which we call life eludes our grasp, and resists our efforts; we see it dimly shadowed now and then within the luminous mist, but the mist obscures our sight, and the light it radiates hides, as it were, by its own brightness; we can trace it through many an intricacy, but the point is soon reached where that which we can trace is limited by that of which we can only see the effect. Still, if hypothesis enables us better to discern that which is in sight—to discover more of its details, to see its relations more clearly, to grasp its character more firmly—the result is surely worth an effort, and there can, therefore, be no harm in trying to push our way, so to speak, as near as possible to the source of vitality.

What, then, is the source of the energy that is manifested in the animal body, and in the processes of human life—from a sigh to a convulsion? Whence and how is motion produced by the muscles? and whence is the mysterious nerve force derived that excites the muscles to contraction? At the outset it should be understood that, according to modern science, no energy can be manifested which does not exist before in some other form. The energy that is made manifest, alike in the combustion of coal or in muscular action, must exist before as a definite form of energy—inconspicuous it may be, but not less real.

In the light of Tyndall's classical researches we are compelled to believe that in every substance about us there is the minute motion of heat corresponding to its temperature. We know that not only may a piece of iron be the seat of the atomic motion we recognize as heat, but it may also be the seat of the atomic motion of electricity, and can be made the seat of the atomic motion of sound. If we consider a piece of glass instead of iron, the co-existence of atomic movements becomes more complicated, because light is transmitted, and, if the glass be tinted, only light of a particular kind will filter through the coloured medium. This co-existence of atomic movements—comparable, maybe, to hornpipes, quicksteps, polkas, quadrilles, and the like—is, for our purpose, important to remember. The discoveries of histologists suggest that all organic tissues—muscle, nerve, bone, and so on—possess a structure of complex and definite form, which may determine the direction and character of the minute motion between their constituent atoms.

A small quantity of musk may give off, in a still room, a sufficient number of particles to sensibly affect the olfactory nerves of any person entering the room, and yet the total amount may be so minute that, after years, no loss of weight in the original substance can be detected by the most delicately constructed chemical balance. What, then, is the size of the individual particles, and can they be larger than molecules? They pass off in still air; they move; what is the source of their motion? Why do they pass away? Observation is certain, but its interpretation introduces uncertainty in proportion to the extent to

* "The Dynamics of Life." By Sir William Gower, F.R.S.

which inference is involved; but there is a region in which we must recognize hypothesis as absolute—a region below the surface whence no reflected light can pass, but whence all observed phenomena proceed. It would appear that the dissemination of the minute particles of musk is due to a propulsive energy, and this must be an intermolecular force which we can best conceive as motion—motion in such excess of the intermolecular attraction as to expel from the musk the molecules that are upon the surface. The relation of heat to the emanation of odours strengthens the belief that intermolecular motion is the form in which the energy exists that expels the molecules from the mass and propels them through the air.

In all substances there seems to be an attraction among the molecules which unites, and a peculiar motion which tends to separate, and these two opposing forces may be very unequal or nearly balanced, and we have accordingly a very stable substance or an unstable one. For example, yellow phosphorus cannot be in contact with air without oxidizing—it gives off white fumes, burns slowly, and forms phosphoric anhydride, the atoms at the surface joining those of the oxygen in the air; there is, as it were, among the individual molecules of phosphorus a keen desire to leave the family circle. In the case of carbon we have a condition of things not far removed, comparatively, from that of phosphorus; the motion which tends to separate the molecules of carbon has to be increased by adding that of heat before the attractive force can be overcome. So also in the explosion of a mixture of coal-gas and air, the effect of a spark on gunpowder, or the simple added motion of concussion in a quantity of nitro-glycerine—all these are examples of the disturbance of chemical equilibrium by added motion, which, so to speak, sets up the necessary rhythm among the molecules—beats time to enable them to keep step with their companions in the new combinations formed.

We have long been accustomed to ascribe the manifestation of energy by muscles to chemical combination—latent chemical energy. It is conveyed into the body by food on the one hand, and oxygen on the other; the food comes directly from vegetable and animal life, but all is ultimately traceable to the former. In growing plants, simple compounds—especially carbonic acid and water—are broken up under the influence of light and heat. The light and heat are essential in order to promote chemical change, and the evidence is conclusive that they—light and heat—disappear in the process: that is, the minute motion tears asunder the carbon, oxygen, and hydrogen, and to do this it has to pass into the molecules of their elements and it remains in them—slowed down, so to speak. This process in the *plant* is reversed when chemical union occurs in the animal body, in which vegetable tissue is burnt as in a furnace. The original simple compounds—carbonic acid and water—are reproduced: that is, solid carbo-hydrates are gasified, and the energy that was hidden is revealed and partially released—the motion of the light and heat passes between the atoms of the elements that are separated, and remains until the new conditions permit its liberation. It is the sunshine, near or distant, recent or long ago, which constitutes the source of the energy—which, in fact, is the energy—manifested in animal life; and we get, in a sense, second-hand sunshine by the combustion of coal—decomposed vegetable tissue.

It is one of the most familiar facts of physiology that all muscular action is accompanied by chemical changes, by the formation of simpler chemical compounds than those which constitute muscular tissue, and especially by the formation of carbonic acid in combustion. The stimulus which makes a muscle contract may be conceived as motion and as *added motion*, the effect being like that which makes a fire burn or gunpowder explode. As the lighted coal goes on burning because the released motion of heat acts as a stimulus to the adjacent molecules—increasing this motion so as to release them—so the released motion in muscular contraction acts as a stimulus which is propagated with intense rapidity along the fibre comparable to that which occurs in a gas or explosive substance. It is often said that protoplasmic substance has a property of contractility, a peculiar result of life. In muscle there is only a change of shape, not of size, and there is no real drawing together; alike in a muscle and in an amœba, the change is the result of some external stimulation, a form of energy—that is, of motion. May the process not be the same in each case—simply a release of atoms and a release of motion by added motion, definite in character, in relation to the place, character, and degree of the added motion which excites it?

In living tissue we may, conceivably, have other forms of motion than those we meet with in inorganic matter. But we are only justified in assuming the unknown when it is certain that the known is inadequate. The nature of nerve force is unknown, but it is capable of propagation along a nerve fibre, and, this being so, it must be either a thing moved or a form of motion. Can we form any conception of the nature of the motion, if, indeed, it be a form of motion? A pretty conception of the nature of nerve force is its resemblance to electricity, a nerve fibre being like an insulated wire, and the nervous system a complicated electric battery, the circuit of which may be completed by the touch of a hair, the hum of a bee, the scent of flowers, and so on, so as to transmit messages to the brain. All the facts we know regarding the production of nerve energy show that it is attended by chemical combination such as that which accompanies muscular contraction. Nerve tissues are the most elaborate, unstable, and delicately equipoised of all the tissues with which we are acquainted. Does it seem strange that conduction so rapid as we know that of nerve force to be, should be a result of chemical action? Think of the rapidity with which a train of nitro-glycerine will explode, and the chief part of the difficulty vanishes. We thus conceive that the transmission of nerve energy is the conduction of released motion by means of propagated chemical action along the molecules of the fibrils.

The force which turns a delicate chemical balance may be minute, but think what takes place when the lightest touch of a hair upon the skin of the leg acts on the brain and is perceived! Such delicate equilibrium exists between the motion of the atoms and their restraining attraction, that the motion of the hair, added to that already present, releases atoms and releases their superfluous motion—comparable, in a way, to the shivering of a sheet of glass into a thousand fragments by touching it with a red-hot wire. This instability of nerve tissue may be due to the presence of phosphorus, an element which, as we have noted, has naturally an atomic motion in excess of its restraint; its presence may alone make the motion almost equal to the restraint in the living tissue of which it forms part, so that the least disturbance will set molecules free something after the fashion of the disseminated musk.

The motion of the nerve impulse disturbs by its addition the preceding equilibrium and increases the motion in the structures that receive it, so that in them it exceeds the attraction, and there is proportional release of atoms and of energy. Throughout the nervous system, from the sensory periphery, on which external energy acts, to the

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motor periphery, where, through the muscles, the outer world is acted on and other forms of energy are released, all the processes vary only in place and in degree, and not in dynamical character. We may see in the process of cell formation something of chemical change, and an influence by which latent energy is specially directed to certain ends; but how far physical energy enters into the influence we have no perception. We have no evidence that any one element that is produced in the body, that any form of cell or similar organism, needs more energy for its production than another. Indeed, we have no real proof that any energy is needed.

What we have said on this subject represents only a peep through the keyhole into nature's laboratory, and the inferences we have drawn from the observed phenomena may be entirely wrong. However this may be, it would seem that among the atoms and molecules, or foundation stones of all living things, there is a regular rhythm—swing of the pendulum—from the atmospheric gases through vegetable tissue to muscular fibre and back again; but we see it in outline only, as we see the horseman riding swiftly past us in the twilight.

CALCIUM IN THE SUN.

By Miss Agnes M. Clerke,

Author of "The System of the Stars," "A Popular History of Astronomy during the Nineteenth Century," etc., etc.

ONE of the most surprising facts in solar physics is the wide diffusion of calcium vapour near the sun. Difficult to explain, and impossible to have been anticipated, it has, through the progress of photographic research, assumed fundamental importance. A substance glowing with violet light of the well-known H and K qualities mounts to the summits of the tallest prominences, reaching, if not transcending, in spasmodic outbursts, heights of some three hundred thousand miles above the photosphere; is wreathed into voluminous spirals constituting faculæ under a novel aspect, with which the entire solar disc is found to be diversified; and radiates so profusely as to give rise, at certain epochs, to double reversals in the general solar spectrum of such a character as to transform the sun, *pro tanto*, into a bright-line star.

To designate this substance off-hand as calcium might, indeed, until quite lately, have been deemed incautious, since opinions were divided as to its true nature. And not without some show of justification. The reasons that "gave one pause" were twofold. They might be distinguished as gravitational and spectroscopic. Was it conceivable, it might be asked, that a vapour *forty times* more dense than hydrogen should invariably be encountered at equal or greater altitudes—at altitudes, moreover, far beyond the apparent range of the lighter atoms of sodium and magnesium, plentiful though they be lower down? For the high-level chemistry of prominences, so far as the analysis of their light shows, is extremely simple. They are composed of hydrogen, helium, and "calcium." It is true that their ultra-violet spectrum includes a few unknown lines, the future interpretation of which is, however, unlikely to subvert the truth of the above statement.

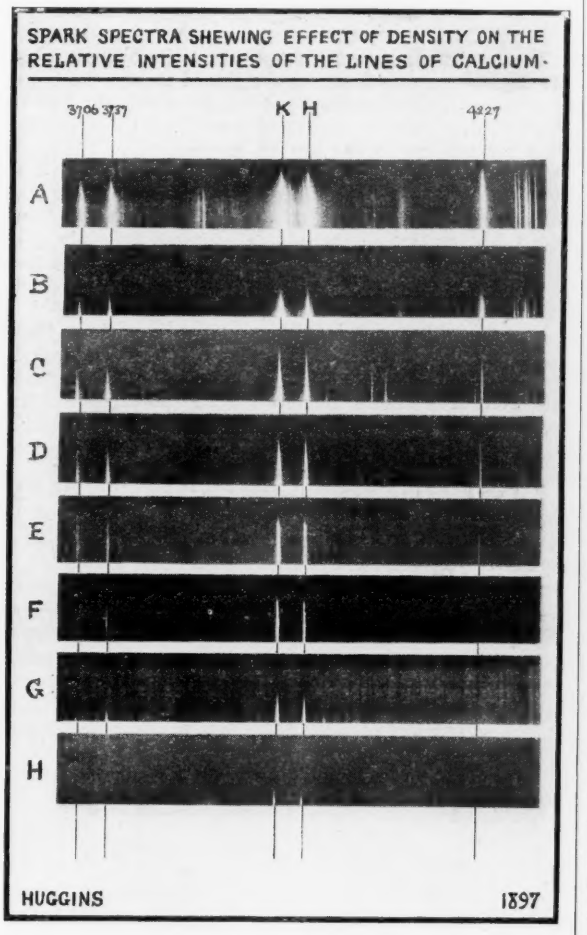
We have now to consider the vexed question of the calcium spectrum. It comprises, when fully developed in the electric arc, several scores of lines, some collected into doublets and triplets, many others scattered singly over the colour-scale. Among them a bright blue ray of wave-length 4227 (ten-millionths of a millimètre) is conspicuous under ordinary conditions. Such, however, do not favour the development of H and K. At the temperature of the Bunsen flame, these can barely be got to show in long-exposure photographs. Electrical excitement is needed to bring out their inherent strength, which grows as if at the expense of their neighbour in the blue. The progressive enfeeblement of the latter, as the arc is exchanged for the spark, suggests ultimate extinction at a still higher pitch of molecular agitation, and the reduction of the calcium spectrum—since all its visible components throw in their lot with that at wave-length 4227—to H and K, besides two similarly affected ultra-violet pairs. These inverse symptoms of intensification and fading in the violet pair and blue line respectively, were connected by Sir J. Norman Lockyer with the dissociative effects of high temperatures. He considered that calcium, partially broken up in the laboratory, and completely torn to pieces by the fierce solar heat, is represented in the chromosphere and prominences by its lightest constituent, a substance distinguished by the emission of the H and K radiations dissevered from all others. Now this hypothesis, plausible at first sight, proves, on further inquiry, to be hampered by all manner of difficulties, physical, chemical, and spectroscopic. But their discussion has been rendered unnecessary by the circumstance that the hypothesis has been shown to be superfluous.

In a paper read before the Royal Society, June 17th, 1897,* Sir William and Lady Huggins announced their success in simplifying the spectrum of calcium down to the point exemplified in the solar prominences, by reducing the density of the emitting vapour while its temperature remained constant. The progression of their experiments is shown in our plate.† The spark was, to begin with, passed between calcium electrodes; and the blazing aspect (as it may be termed) of H and K, of the companion pair in the ultra-violet, no less than of the blue line self-depicted in Fig. A, corresponds to the considerable amount of the metallic gas disengaged and illuminated. The marked change produced by substituting a platinum electrode for one of the calciums, comes out in Fig. B; and it will be noticed that it tells most on the lines of shortest wave-length. Fig. C represents the effect of taking the spark between platinum terminals moistened with a strong solution of calcium chloride. The fading of the blue line is obvious, its estimated intensity being now only one-fourth that of H and K. Still more significant are the remaining five photographs in the plate. They portray the spectra obtained after successive washings of the platinum electrodes, the arrangements remaining otherwise undisturbed; that is to say, the remnant of calcium vapour present was rendered more and more tenuous, until its detection, even by such an extraordinarily fine test as light-analysis supplies, became a matter for surprise. At this final stage, represented by the lowest figure of our plate, the condition of the solar prominences was at last seemingly realized, since H and K stood alone in the spectrum. This triumph of artifice, thus for the first time achieved, led irresistibly to the conclusion that the effect in the solar structures was due to the same cause as in the laboratory—that the irreducible minimum of radiation was arrived at, in the one case as in the other, through the unimaginable *emaciation*, so to speak, of the glowing substance. Nor,

* *Proceedings*, Vol. LXI., p. 433.

† Our illustration is reproduced from original photographs by kind permission of Sir William and Lady Huggins, from the plate accompanying their paper in the *Proceedings of the Royal Society*, Vol. LXI., No 377, p. 440.

indeed, are spectral phenomena the only grounds for holding chromospheric and coronal materials to be in a high degree subtle. The inappreciably resisted passage through them of sundry comets has time after time demonstrated the fact. What is new is the discovery that precisely this subtlety prescribes the character of their spectrum, so far at least as calcium is concerned. For heat influences, we must remember, were, in the Tulse Hill experiments, virtually eliminated by being kept moderate and uniform. The spark employed to produce luminosity was of unusually small intensity—was, indeed, "purposely made as little hot as possible in order to emphasize the important fact that



the determining condition of the spectral changes under discussion was not one of increase of temperature." Our authors add the following remarks:—

"In the modifications of the calcium spectrum arising from variations in the relative intensities of the lines which have been discussed in this paper, and which correspond to those observed in the celestial bodies, there does not appear to us any reason for assuming, much less any direct evidence in favour of, a true dissociation of calcium—that is, its resolution into chemically different kinds of matter. It would be remarkable if, by decomposition through increase of temperature, a large number of lines of a spectrum should become relatively enfeebled, and that as the result of decomposition a spectrum should become simpler, and not, as analogy would suggest, more complex."

While the chromospheric spectrum of calcium, as at present known, consists of H and K only, it may eventually be found to include a second pair of lines too highly refrangible for registration by the methods available at Chicago or Paris. For in Sir William and Lady Huggins's photographs, radiations at λ3159 and λ3179 showed persistently, imitating the behaviour of H and K, and belonging presumably to the same immediate vibratory system. They are too remote for convenient representation in the plate. Their importance to spectral theory may yet prove very great.

The Fraunhofer lines due to calcium are numerous, and in several instances conspicuous. But H and K, dusky and diffuse, markedly dominate over the rest. A curious circumstance regarding the couple as thus presented in the ordinary solar spectrum has lately been brought into evidence. It appears that they integrate the absorption exercised at two different levels in the sun's atmosphere. The central bands are produced in the reversing layer; the "wings" are appended lower down near the photosphere in a region of greater pressure. This dual origin of Fraunhofer's H and K was inferred a couple of years ago by Mr. Jewell of Baltimore, on the ground of certain spectrographic measurements; it was amply confirmed by Mr. Shackleton's Novaya Zemlya photograph of the prismatic "flash" at the edge of the eclipsed sun, in which the famous calcium pair appear strong, yet sharply terminated. This state of things indicates an unexpected degree of rarity in the calcium ingredient of the reversing layer—a degree of rarity which we are no longer entirely without the means of gauging. One of the most significant results of Sir William and Lady Huggins's latest investigation is to afford a standard of comparison on this point; and out of the series of their photographs we should be inclined to select No. 4, marked "D," as the best match for the eclipse record. It shows, we may remind our readers, the spectrum of a spark passing between platinum terminals, from which a solution of calcium chloride had been washed off with water. The density of the ignited calcium vapour must then have been slight indeed, and it can scarcely, in the reversing layer, exceed a fraction of an atmosphere, even allowing for the fining-off effect upon spectral rays of production in a heterogeneous mixture. True, Messrs. Jewell, Mohler, and Humphreys last year estimated the pressure of calcium in that stratum at from three to six atmospheres,* but on grounds as yet imperfectly understood and highly precarious. Most noteworthy is the fact that it remains sensibly uniform through a depth of at least two hundred and fifty miles. Yet, under the influence of solar gravity, the density of a gaseous substance in atmospheric equilibrium should increase twofold for each furlong of descent. In a single mile there would be eight such doublings; between the top and bottom of the reversing layer the gain in compactness should be at least 2^{2000}-fold—a number meaningless from its immensity. Since no sign of the exertion of this enormous power is traceable until the low-lying stratum is reached, where H and K acquire the shadowy borders displayed in the Fraunhofer spectrum, gravity must be in *some* way counteracted. In *what* way remains problematical.

Anomalies in the distribution of materials near the sun may accordingly be looked for, and the vast heights to which sparsely scattered metallic molecules apparently ascend cease to be incredible. Much of its force thus

* *Astrophysical Journal*, Vol. III., p. 138.

falls away from one objection to accepting the otherwise almost inevitable inference that true calcium in a state of chemical integrity, although of the utmost physical tenuity, is a main ingredient of the solar chromosphere and prominences. It is not unlikely that sodium, magnesium, and perhaps other elements, are invisibly associated with it, calcium retaining luminosity long after the other elements have become extinct. Its persistence in light emission may be in part explained by the concentration of vibrative energy, just verging towards total cessation, in the violet twin-lines, the special import of which to astrophysics has unfolded further with each advance in knowledge.

SOME NEW VIEWS AS TO THE PLANET VENUS.

By Camille Flammarion, F.R.A.S.,

Author of "Astronomie Populaire," "Les Etoiles," "Les Terres du Ciel," "La Planète Mars," etc.

THIS neighbour of our own world, which it equals in size, and nearly equals in weight and density, is the nearest to us of all the heavenly bodies, with the exception of the moon. In its circuit around the sun it frequently comes a great deal nearer to us than our other neighbour, Mars—in fact, to a distance of only forty millions of kilomètres, whilst Mars never comes nearer than sixty-four millions of kilomètres. Its apparent diameter then attains sixty seconds of arc—that is to say, one-thirtieth of the diameter of the moon—so that a telescope of a magnifying power not exceeding thirty diameters will show us Venus as being apparently of the same size as the moon viewed with the naked eye. An optical instrument of a magnifying power of three hundred diameters will, therefore, make the diameter of this planet appear to be ten times larger than that of the moon, while a glass magnifying six-hundred-fold will make it appear to be twenty times larger.

These are dimensions excellently adapted for telescopic research, and, in the case of Mars, the results of observation have been truly marvellous for diameters generally far less than these, for Mars is both farther distant and smaller than Venus. Yet our knowledge of the planet Venus is incomparably less advanced than it is in regard to Mars. In fact, we hardly know anything at all about the former as yet, and are, in this respect, groping along at a mere snail's pace.

The reason of this fact lies in the difficulty of observation. In the first place, since Venus is circling around the sun in an orbit interior to ours, the epochs of its nearest approach to us are those in which it passes between the sun and our planet; its illuminated hemisphere being naturally, in all cases, turned towards the sun. The result of this to us is that it exhibits phases like those of the moon. The nearer Venus approaches the earth the larger becomes its diameter, but at the same time its crescent becomes narrower in proportion, and we see less of its surface. And, conversely, the farther the planet recedes, its disc becomes more rounded, but at the same time much smaller. Now herein lies the observer's trouble. We never see Venus fully illuminated, except under the worst conditions, for then it is on the side of the sun further from the earth, and is reduced to its minimum dimensions, being then, moreover, practically inobservable on account of its proximity to the sun and of its great distance from the earth.

Another circumstance which interferes no less with successful observation is that the planet is surrounded by an immense atmosphere, about twice as dense as, and far more elevated than, ours. The absorption of solar light by this atmosphere is considerable. The illumination of the sky in the daytime on the earth gives us some idea of the enormous amount of light diffused by our air, and reflected by its molecules. Now this atmosphere is impregnated with light, the blue rays of which are reflected to us, the other colours of the solar spectrum being absorbed. The results of photometric, actinometric, and calorimetric experiments concur in showing that our atmosphere absorbs about one-third of the solar rays that reach the planet; two-thirds only come right down to the surface of the earth even in the case of a zenithal sun. Were an observer, placed on the moon, say, to examine the terrestrial disc within the field of view of a telescope, he would fail to see it with anything like the distinctness with which we descry the full moon. The central region of the disc would have lost two-thirds of its brilliancy, as the atmosphere would act as a veil and reduce the light received by the surface from the sun by one-third; and it would diminish it by an additional one-third in the reflection from the surface to the eye of the observer. Then, as absorption would increase with the obliquity, and with the depth of the atmospheric layer—that is to say, with the distance from the centre of the disc—such absorption would become so considerable that most certainly the geographical configurations would be entirely effaced for at least one-half of the distance between the centre and limb of the disc.

Now, perfectly concordant observations have shown that the atmosphere of Venus is about twice as dense as, and of considerably greater extent than, that of our earth,* so that even if we were able to see the planet when in opposition to—*i.e.*, fully illuminated by—the sun, we could distinguish scarcely anything of its surface, though the skies over Venus were ever so clear.

But we have just seen that owing to the position of the planet we can never observe its full face; besides, there is nothing to show that its atmosphere is free from clouds. On the contrary, spectral analysis has shown water vapour to be present in it; indeed, its close proximity to the sun cannot but be favourable to great evaporation. Besides, this planet, when examined through the telescope, always

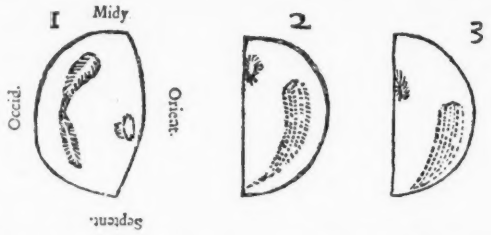


Fig. 1.—Cassini's Original Sketches of Venus, 1666 and 1667.

displays a dazzling brightness in perfect accord with the presence of a layer of clouds perpetually present in the higher regions of the planet's atmosphere, and which reflects back to us the greater part of the sunlight.

In view of these several facts, it would seem to be extremely difficult to detect the actual surface of Venus from the earth. Observation, moreover, points to the same conclusion.

No astronomer has ever yet tried to draw a telescopic picture of Venus without noticing the difficulty, peculiar to this planet, of being quite certain of any of its aspects.

* *See Bulletin de la Société Astronomique de France* for 1897, pp. 134 to 137; also *Astronomie Populaire, Les Terres du Ciel*, etc.

Generally we perceive nothing; a dazzling whiteness, but no spots at all—the very opposite of what happens in the case of the moon, Mars, or Jupiter. Even where, by some extraordinary chance, the observer does perceive some marking, it is altogether undefined, doubtful, faint, and in many cases evanescent. If we are convinced of the reality of some marking or other, and make a sketch of the disc, it often happens that in a few hours, or one or two days, a week, a fortnight or so, we may again observe practically the same configuration. We take the drawings, which seem to be in agreement more or less, and we fancy we can trace in them the rudiments of a Cytherean chart. (Thus a new map of Venus is published on an average every ten years.) In the same way, another astronomer makes other drawings which are in as good agreement with each other, but which very often do not at all resemble the first series.

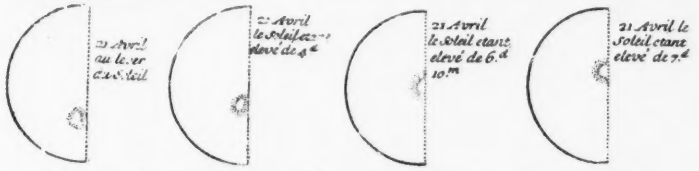

21 Avril au lever du Soleil
21 Avril le Soleil etant elevé de 4.d
21 Avril le Soleil etant elevé de 6.d 10.m
21 Avril le Soleil etant elevé de 7.d

Fig. 2.—Further Sketches of Venus by Cassini, as preserved by his son, April 21st, 1667.

Similarly, if we compare drawings made at different epochs—say, the drawings of last century—with those made at the present time, they bear no resemblance. In 1726, Bianchini, working under the bright Italian sky, made a number of drawings, and traced a map with continents and seas; and these configurations the author considered sufficiently certain and stable for nomenclature, notably the regions Galileo, Columbus, Vespucci, and King Emmanuel. If we look for these configurations in modern illustrations of Venus, we shall look in vain; whereas the general aspects of the moon, Mars, or Jupiter may be readily identified even in the oldest drawings.

Thus, in the first place, there is this essential difference between Venus and the other planets, that nothing sure, stable, or perpetual is discoverable upon its disc; while, on the other hand, the conditions under which Venus can be observed from the earth, the absorption by its atmosphere, and the clouds which must overspread it continually, effectually prevent us from distinguishing, except on rare occasions, any of its surface markings. If we carefully examine the observations which have been made for more than two centuries, to determine the rotation of Venus, we find them insufficient for any definite result. We will briefly recall them here.

(1.) The first interesting observations concerning the configurations and rotation of the planet Venus were made by Domenico Cassini, at Bologna, in 1666. On the 14th of October of that year, at 5.45 P.M., he perceived a bright spot near the terminator and two elongated dark spots near its western limb. That was all he noted in this year, for afterwards he was unsuccessful in his attempts to view the planet. It was not until the 20th of April following, that, a quarter of an hour before sunrise, he once more beheld, upon the other half of the Venus hemisphere—viz., the eastern half, then visible—a dark patch, elongated and pointed in shape, and also a brilliant spot near the terminator, lower down or south. A quarter of an hour later, just at sunrise, the bright spot had become sensibly displaced *from the south to the north*. On the morrow (21st of April), at sunrise exactly, he again saw the spot, and again displaced from south to north as on the day before. In rising it reached the centre of the disc, about thirty-six minutes after sunrise. Cassini saw it again on the 9th, 10th, and 13th of May and on the 5th and 6th of June; but no more observations are recorded in his lifetime: in fact, no observations at all until the year 1726.

From these observations Cassini concluded that Venus possesses either a motion of *libration*, or of *rotation from south to north*.

We give Cassini's diagrams and the record of his observations in his own words.*

The sketches (1, 2, and 3) are, for the first, dated the 14th of October, 1666, and for the others, the 28th of April, 1667, a quarter of an hour before, and at, sunrise respectively. "I will not venture," says he, "to express my opinion on these phenomena as boldly as I did on the spots on Jupiter and Mars. Yet I may say (supposing this shining spot of Venus has always been the same), that the planet completes its movement of either revolution or libration *in less than one day*, so that in twenty-three days, approximately, it shows the same aspect."

Thus, according to Cassini, if there be any rotation, it should be in the direction from south to north, and be completed in less than twenty-four hours.

Seventy-three years later,† his son, Jacques Cassini, by way of explanation of his father's observations, added to these three drawings those of the 21st of April, which do, indeed, very clearly show the displacement of the white spot. These we also reproduce here.

Now, nothing is less sure than that dark streak and that white spot. The former, most likely, is merely an optical effect; indeed, Cassini himself attached no importance to

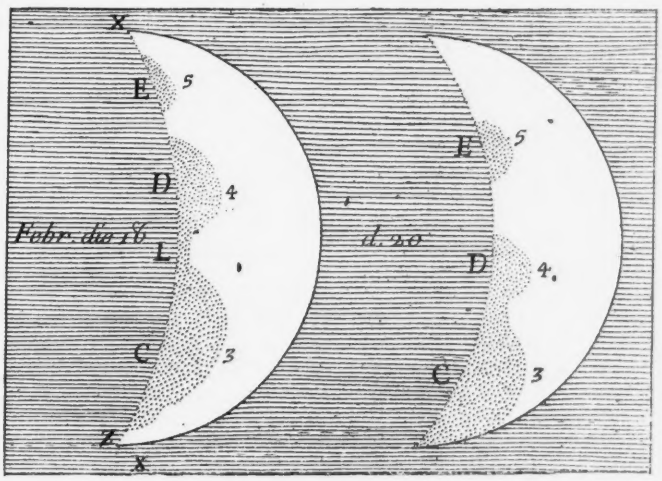


Fig. 3.—Illustrations of Venus by Bianchini, February 18th and 20th, 1726.

* From the *Journal des Savants* for 1667, p. 265. I have reproduced the original sketch, though much defaced. No *exact* copy of it has ever been published, either by his son, or in the works of Bianchini or Schroeter.

† *Elément d'Astronomie*, 1740, p. 511.

it, for it was by the white spot that he thought he could determine the movement of the planet. But he never saw the white spot again, nor has anyone else either. It may, of course, have been real, and been caused by a mass of clouds carried by an aërial current in a northward direction; but it is more closely connected with the terminator than with the planet itself, and must be an optical effect.

This determination of the rotation is, therefore, of no intrinsic value. Be this as it may, the rapid displacement would point to a period of less than one day, as stated by Cassini, instead of twenty-three days, as has been said. In his work, *Astronomie*, Jacques Cassini, wishing to reconcile the observations of Bianchini—of which we shall speak later—with his father's, concluded that the period is probably twenty-three hours and twenty or twenty-two minutes.

(2.) In 1726 and 1727, Bianchini made a series of observations, both at Rome and Albano, with the aid of an excellent object-glass constructed by Campani.* These observations and these drawings we have now before us. In no particular do they resemble or tally with those made by Cassini. Bianchini always saw circular dark spots, cut by the terminator. We here reproduce the two most characteristic sketches. There will be noticed three spots which have shifted in the downward, or southward, direction. The observations were made in the evening, at sunset, and the author takes care to inform us that he has represented the phase *in situ vero*, and not inverted. He estimates the displacement of the spots at fifteen degrees a day, and concludes a rotation of twenty-four days and eight hours, the equatorial line being inclined seventy-five degrees to the ecliptic.

These spots are just as uncertain as those of Cassini's. The luminosity of the crescent of Venus is always much enfeebled as it gets nearer to the terminator, as it is there that the minimum of light is received from the sun. All that is noticeable is a somewhat vague variation of shade, and often in Bianchini's observations themselves one and the same observation is illustrated by two drawings, between which there is scarcely any resemblance—nay, some of which very appreciably differ. Thus, for example, on January 7th, 1728, there are shown four large spots on one drawing, and only three on another. Also, all these patches are shown to be of a circular shape. Now, although the Italian astronomer considered these patches as sufficiently certain and permanent to give them names (Christopher Columbus's Sea, Vespucci's Sea, Galileo's Sea, etc.) and to construct a map or chart, and a globe too, nothing can be less certain than their existence or situation.

Fig. 4.—A Sketch of Venus by Schroeter, 1788. (*L'Astronomie*, 1890, p. 331.)

(3.) A third observer, after Cassini and Bianchini, to study the planet Venus, and who did so in a particularly painstaking manner, was Schroeter, the able and industrious astronomer of Lilienthal. He commenced his observations in 1779, and continued them until 1795. His observations were published by him in a remarkable work which we also have before us.† It is illustrated by a very large number of drawings, not one of which shows any spots bearing the least resemblance to those of Cassini or of Bianchini. An idea of Schroeter's may be formed by the inspection of Fig. 4.

This observer's first impression was that those spots or marks were probably nothing but illusions. And, in truth, that faint, dark image, remaining motionless for two months, can be nothing but either an optical illusion or an atmospheric effect. This, too, is what Schroeter himself says. In our terrestrial atmosphere we often find that certain aspects, such as condensation, a temporary clearing off of mists, and the like, reappear at the same hours for several days in succession, being dependent upon the sun. However, the Lilienthal astronomer, having noticed a little later on, in 1792 and 1793, certain unevennesses or jagged edges, of a rapidly varying form, especially at the cusps of the crescent, concluded that the time of rotation was twenty-eight hours twenty-one minutes. That was also the period of time assigned to it by Jacques Cassini, from his father's observations. Schroeter was influenced by those figures, for it is easy enough to see that it was absolutely impossible to deduce the time of rotation from the mere reappearance of a few more or less uncertain white points upon the terminator of the crescent of Venus.

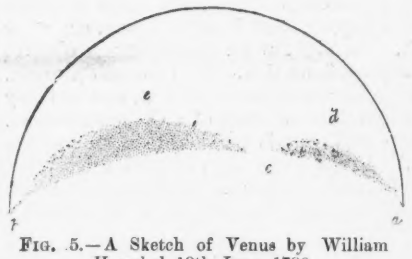


Fig. 5.—A Sketch of Venus by William Herschel, 19th June, 1780.

(4.) The fourth observer worthy of notice who has dealt with the physical aspects of Venus is the immortal Sir William Herschel. He, however, expresses little satisfaction at the results he achieved in this respect, although he had started his observations with the conviction that Cassini and Bianchini had seen something real. He appears to have published his paper* for the sole purpose of criticizing the confidence with which Schroeter announced that he had discovered mountains upon Venus six times higher than Chimborazo, *i.e.*, about twenty miles high, and that he had ascertained its rotation. Herschel denied emphatically the existence of any mountains on Venus. He does describe certain faint spots which he believed he had seen upon a few occasions, and whilst crediting the idea of the planet's rotation, he declares that neither the sense nor the period of the rotation is to be deduced from them. From this memoir, which I have also consulted, I extract Fig. 5, drawn by himself on the 19th June, 1780. In his opinion these spots frequently assume the aspect of optical illusions, or, as he expresses it, "optical deceptions."

For an astronomer like Sir William Herschel to give up the observation of Venus, means that he must have recognized the impossibility of discovering anything from it.

(To be continued.)

* *Hesperi et Phosphori nova Phænomena.* (Rome, 1728.)

† *Aphroditographische Fragmente.* (Holmstedt, 1793.)

* "Observations of the Planet Venus." Royal Society, 13th June, 1793.

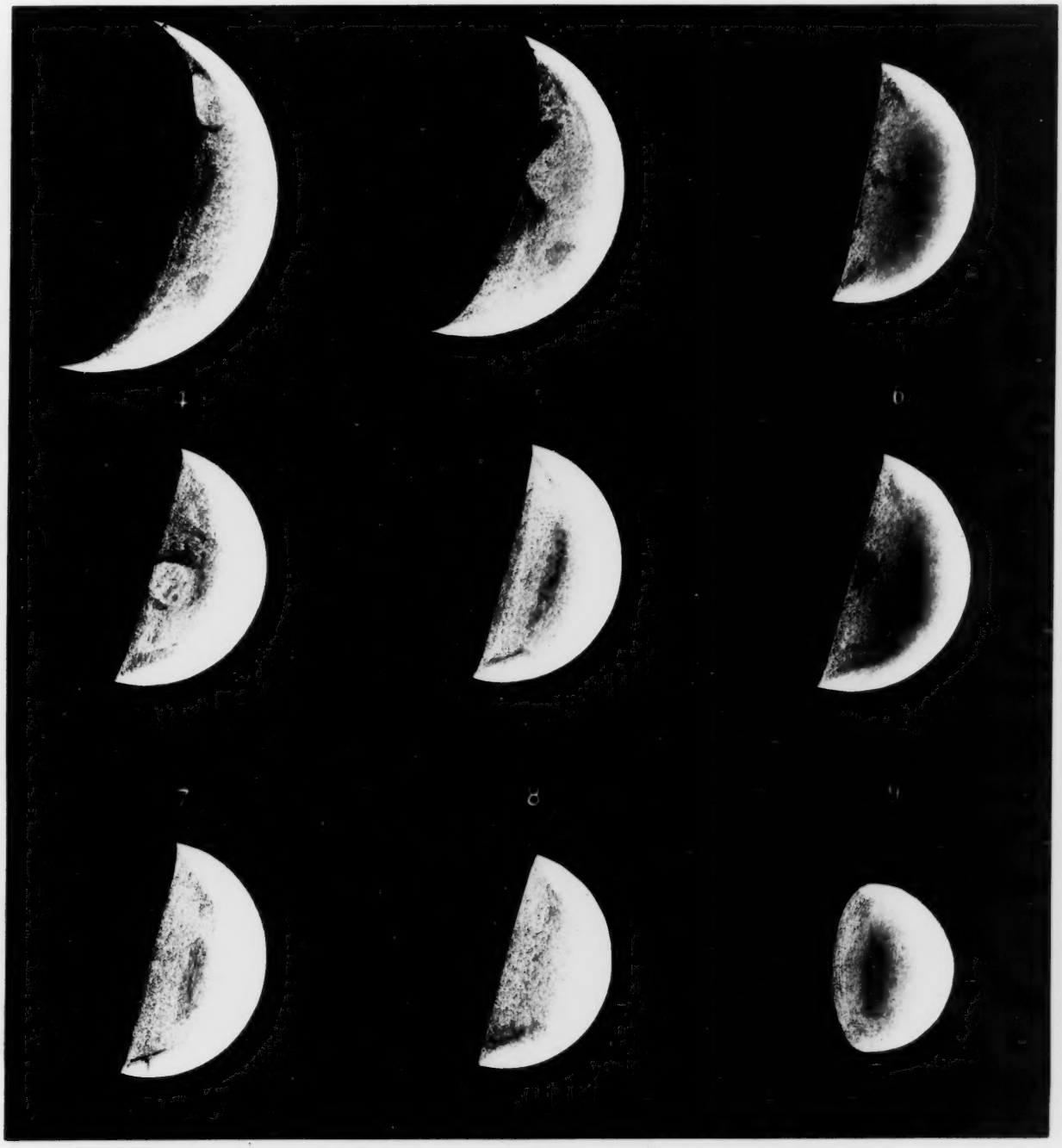
Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

R SCUTI AND OTHER VARIABLES.

To the Editors of Knowledge.

Sirs,—From the apparent maximum of R Scuti on February 27th, noted in Knowledge for June, until the



VENUS IN 1897,

As seen at M. Flammarion's Observatory, Juvisy, France.

	d.	h.	m.		d.	h.	m.		d.	h.	m.
1.—Antoniadi,	June 11	20	45	2.—Antoniadi,	June 23	21	45	3.—Antoniadi,	July 12	21	0
4.—Antoniadi,	July 12	23	45	5.—Antoniadi,	July 14	22	15	6.—Mathieu,	July 14	22	15
7.—Flammarion,	July 14	22	30	8.—Antoniadi,	July 24	21	0	9.—Antoniadi,	August 30	21	30

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following May, the star was inconveniently placed for observation.

Computed from the old elements, maxima were due February 24th, May 6th, and July 16th. On May 1st the star was barely visible in the fieldglass, and on the following night was invisible in that instrument. The next clear night, May 6th, it was found with the two and three-quarter inch refractor, and there was a complete reversal of phase, for instead of being at maximum, as computed, the star was at a very faint minimum close to tenth magnitude. On June 11th it had reached a magnitude of 5·4, and then fell to 6·25 on June 29th. It then rose to 5·45 magnitude July 17th, at which date a maximum was due in regular succession. It was last night at sixth magnitude. This star is quite interesting; its alternate bright and faint phases, and particularly its complete reversals, seem, in connection with its position in the Milky Way, to make it worthy of the best thought of the day, if variable star observation and study are of the importance attached to them by eminent astronomers.

R Hydræ passed a maximum May 17th, at 4·1 magnitude, and seventeen days later than the predicted date.

R Corvi was not within my view till after the predicted date of maximum, March 27th, had passed; but on April 4th it was a fine star 6·5 magnitude, and was lost April 25th at 8·2 magnitude.

S Coronæ passed maximum March 24th at 7·3 magnitude. It seemed to brighten April 20th, was lost June 9th, and definitely glimpsed June 22nd.

T Ursæ Majoris reached maximum June 5th at seventh magnitude, and remains still in view, but faint.

R Leonis seems to have passed a minimum tenth magnitude June 16th, which was the proper date for that phase computing from the old elements, but fourteen days short of the one hundred and sixty-nine days usual between maximum and minimum, counting from Yendell's maximum and my own given in Knowledge for March. The next maximum of this star—which Mr. Yendell, in *Popular Astronomy* for June, says is, next to Mira, the most interesting of the variables—will be of increased importance, as it will show (to the present writer at least) between which of the phases, whether on the rise or the fall, the shortening of the period occurs.

Dr. Chandler has corrected the elements of U Cephei by adding forty-five minutes and making the time of its changes that much later than the time given in the "Companion." This satisfies my conviction, chiefly in my inner consciousness, that the star for some years has been behind time in reaching minimum.

U Coronæ is another star of the same type that seems to need a similar revision.

The new variable S S Cygni of the U Geminorum type is receiving considerable attention. It is within range of the fieldglass at maximum for a few days, reaching 8·2 magnitude.

David Flanery.

Memphis, Tenn., U.S.A.,
28th July, 1897.

"MORE ABOUT ANTIVENENE."

To the Editors of Knowledge.

Sirs,—This article contains a statement that snake poison introduced into the stomach does not produce any active poisoning effects. If my memory serves me, there is a directly antagonistic statement in a paper by Drs. Reichardts and Weir Mitchell, which is preserved in the records of the Smithsonian Institution.

Again, the rattlesnake is spoken of as being one of the most deadly of the serpent tribe. I think that a reference to the American authorities already quoted will sufficiently disprove this. In fact, I believe that rattlesnakes are, as a group, the least deadly of the North American poisonous snakes, and that their venom is not so virulent as that of the water viper (*Ancistrodon piscivorus*), the copperhead (*A. contortrix*), and the coral snake (*Elaps*), which, with the rattlesnakes, exhaust the North American *Thanatophidia*. There is, I imagine, no doubt that many of the South American, Australian, East Indian, and African snakes are infinitely more poisonous than any of those of North America. Lionel Jervis.

[Prof. Fraser's experiments bear out the statement made, that snake poison can be introduced into the stomach up to a certain extent without producing any active poisonous effects. For instance, a cat was made to swallow one-fifth of the minimum lethal dose; this dose was gradually increased till, on the hundred and sixteenth day, it received into the stomach at one time a dose eighty times larger than would have killed a clean cat by injection—yet no observable disturbance was produced by these doses.

It is generally admitted that the rattlesnake is a genus of highly specialized venomous snakes, and that its poison is very deadly, rapidly paralyzing the nerve centres, and affecting the respiratory and circulatory functions.—J. G. McPherson.]

THE VEGETATION AND SOME OF THE VEGETABLE PRODUCTIONS OF AUSTRALASIA.

In reply to a correspondent's questions, which it seems unnecessary to reproduce here, Mr. Hemsley writes:—"The leaves of most Australian plants, especially of those in the drier regions, are woody (rarely succulent), and either small and often spiny, or larger with the surfaces vertical. Climatic conditions are directly or indirectly connected with these curious modifications, which, coupled with anatomical peculiarities, render superficial evaporation exceedingly slow, and thus enable plants to live through the prolonged droughts which are not infrequent. The prickly, woody nature of the leaves also protects plants from destruction by animals. Aromatic plants abound in Australia; the gum trees, or *Eucalypti*, being remarkable for their resinous secretions."—Eds.

Notices of Books.

Elements of Electro-Chemistry. By Dr. Robert Lüpke. Translated from the German by M. M. Pattison Muir, M.A. (Grevel & Co.) Illustrated. 7s. 6d. So far as we know, this is the first book in English which sets forth succinctly the experiments by means of which the theories of electro-chemistry are elucidated and the laws deduced. It is true that Ostwald's "Chemistry," etc., and various journals contain information of this kind, but not in that form which is most convenient. Dr. Lüpke, however, has brought together many hitherto scattered fragments, and a prominent feature of the work finds its expression in the fact that the fundamental conceptions of physics and chemistry, as far as they appertain to the subject in hand, may be rendered intelligible to students by experiments carried out with simple apparatus, most of which can be rigged up by the average student who knows how to manipulate glass before the blowpipe. Van't Hoff's theory of solutions, although not at first sight relevant to the subject, here finds its proper place. Raoult's laws relating to the determination of molecular weights; Beckman's measurement of boiling points, plasmolysis, and the law

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of De Vries; Traube's proof of osmotic pressure; Hittorf's transport numbers; and the dissociation theory of Arrhenius, are all put in a nutshell, so to speak; while the technical aspects of electro-metallurgy, which are so important at present, are dealt with in their proper places. Dr. Lüpke's book is a desideratum in every chemist's library.

Through a Pocket Lens. By Henry Scherren, F.Z.S. (Religious Tract Society.) Illustrated. 2s. 6d. An idea far too common among those whose tastes incline them towards the study of natural history, is that nothing of scientific value can be done unless a microscope of high power, and other generally prohibitive auxiliary appliances, are accessible. How this notion is wide of the mark may be clearly seen by an inspection of the little book under notice, which contains an amazing amount of accurate information gleaned by careful observation, and seconded by the aid of a simple microscope, some dissecting needles, a few beakers, capsules, watch glasses, pipettes or dipping tubes, and a pair of forceps—the lot costing only a few shillings. The author has indicated how the anatomy and life-history of quite a multitude of insects and other representatives of animated nature may be effectively studied by anyone, however circumscribed from a pecuniary point of view, if only the will is there, for some of the apparatus can be easily made, and other pieces can be replaced by things available in nearly every house for domestic use.

The Young Beetle-Collector's Handbook. By Dr. E. Hofmann. With an Introduction by W. Egmont Kirby, M.D. (Sonnenschein.) Illustrated. 4s. 6d. When one considers that the total number of insects known is upwards of two hundred and seventy thousand, and out of these more than a hundred thousand belong to the *Coleoptera*, or beetles, the reason why so much literature exists on the subject will be sufficiently apparent, and it will also be obvious that no writer would pretend to cope with such a vast array of living things in a single volume. Dr. Hofmann therefore gives, in an introductory chapter, a general description of beetles; their morphology and development; their habits and how to catch them, and, when caught, how to kill them; and, finally, how to classify and arrange them in the collected form so as best to display their distinguishing characteristics. Then follows a grouping into sections, which are further divided into families, the members of which are described according to external appearances, articulation, mode of reproduction, and method of acquiring the means of existence, etc. A very attractive and useful feature of the work is represented by twenty coloured plates, comprising over five hundred really good presentments of different kinds of beetles.

SHORT NOTICES.

Practical Astrology. By Alan Leo. (*Modern Astrology* Office, Bouverie Street.) Illustrated. 3s. 6d. The author tells us he has only one motive in issuing this work, namely, "the desire to place the science of astrology before the world in its true light, as a science, and not as a fortune-telling jumble of hoary predictive trash." An intimation is advanced that theories of fate, and the law of action and reaction, need the practical demonstration of the law through the agency of astrology. Every assertion in the book is backed up by personal experience, so we are told, and anyone by very little practice in this *science* may unravel the great mystery of life. A marvellous result, truly, for so small an outlay! The ancient Chaldean and Assyrian sages knew how to predict eclipses, and, what was more important to them, how to use such knowledge to the cost of those less informed on matters celestial. With the almost universal knowledge of planetary motions in our own time, it is hardly to be expected that we shall readily be persuaded to turn on a retrograde path of a couple of thousand years, to indulge in the belief that the conjunction of any heavenly bodies whatsoever will solve for us "the riddle of the sphinx."

Memorials of William Cranch Bond, Director of the Harvard College Observatory, 1840-59, and of his Son, George Phillips Bond, Director of the Harvard College Observatory, 1859-65, are in preparation by Edward S. Holden, Director of the Lick Observatory. No adequate biography of either of the Bonds is available. At the request of the daughters of George Bond, Prof. Holden has undertaken to arrange the manuscript material in their hands in an orderly form. The book will also contain selections from the diaries and correspondence of George Bond, as well as an account of the scientific work of the Bonds, together with appendices, giving a complete list of their published writings. A small edition only will be issued. The publishers are Murdock & Co., San Francisco, and Lemcke & Büchner, New York.

Geology of North-East Durham. By D. A. Woolacott, B.Sc. (Hills & Co., Sunderland.) Illustrated. 1s. 6d. net. This little work consists of a reprint of some papers which appeared in the *Sunderland Weekly Echo* in the summer of 1896. The author's aim has been to present facts in a popular style, so as to be understood by persons unacquainted with the principles of geology, and he has, we think, succeeded in his laudable aspirations. Mr. Woolacott displays a wide knowledge of facts and also ability to present them to others in picturesque fashion; indeed, the language employed is much more pictorial than the illustrations used for the purpose, presumably, of adorning the pages. And yet for these primordial works of art our author, in obeisance to the grateful impulse in him, dutifully makes known to the world at large his obligations to the editor of a newspaper.

The Story of the Mine. By Charles Howard Shinn. (Gay & Bird.) Illustrated. 6s. We have here the life-history, as it were, of the great Comstock lode of Nevada, and not in any sense a technical handbook. Still, reading between the lines, it is possible to cull much information relating to the daily life of the miner, which would be very valuable to anyone intending to launch out as a prospector in the Far West. Two brothers, named Grosh, were the real pioneers of the district, and had they not succumbed to adverse elements it is probable that the whole of this history would have been very different from what it is. From the fifties up to the present time we have glimpses of the fortune hunters and their adventures in connection with these famous mines; the transition from simple placer mining to the more complicated processes involved in quartz mining; the excitement of would-be prospectors, and the tremendous rush across the sierras; the development of dependent industries; stock, and stock speculators; and the memorable days of the great Bonanza. Mr. Shinn has the knack of writing in not merely a readable style, but a style which is tru y fascinating. He presents a living picture of the typical figures one meets in the wild West, sharply defining the contrasts between individuals, and one sees clearly the gradual development of a great mining industry as the facts are skilfully piled up by the author.

We understand that a second edition—revised and enlarged—of Mr. Arthur Mee's *Observational Astronomy* is in the press, and may be expected almost immediately. The book contains many portraits, maps, and illustrations, and is designedly a practical work for amateurs. A memoir of the Rev. Prebendary Webb, by the author, is given in an appendix.

The Queen's London. (Cassell & Co.) Part I. 6d. Perfect in realism, excellent in art, marvellous in cheapness.

BOOKS RECEIVED.

An Introduction to Geology. By Wm. B. Scott. (Macmillan.) Illustrated. 8s. net.

The Evolution of the English Alphabet—a Diagram. By Hy. George Taylor Jones, B.A. (Relfe Bros.) 6d.

Glimpses into Plant Life. By Mrs. Brightwen, F.E.S. (Unwin.) Illustrated.

Manual of Ethics. By John S. Mackenzie, M.A. (Clive.) 6s. 6d.

The New Psychology. By Dr. E. W. Scripture. (Scott.) Illustrated. 6s.

A Synopsis of English History. By J. C. Wright. (Relfe Bros.) 6d.

Humane Science Lectures. By various Authors. (Bell.)

Elements of Chemistry. By Rufus P. Williams. (Ginn & Co.) Illustrated. 5s.

A Guide to Zermatt. By Edward Whymper. (Murray.) Illustrated. 3s. net.

Pictorial Instruction.—Object Lessons. By G. Colomb, D.Sc. (Relfe Bros.) 1s. 6d.

Publications of the Bureau of Ethnology. J. W. Powell, Director. (Smithsonian Institute.)

* * **The next number of Knowledge (November) will contain a fully illustrated Literary Supplement.**

British Ornithological Notes.

Conducted by Harry F. Witherby, f.z.s., m.b.o.u.

As announced in the last number of Knowledge, *we commence in the present issue a column which is to be devoted for the future to original notes dealing with the habits, the distribution, the migrations, and the occurrence of rare species, of British birds. To make this record complete and of still greater value to the systematic ornithologist, it is intended, briefly, to extract from every source available all important records of the month, and also to draw attention to any article of especial interest to the British ornithologist.*

Over one hundred ornithologists from all parts of the country have already promised to contribute notes, and it is to be hoped that the column will have universal support from ornithologists, and will become a permanent and valuable record, which will be the means of furthering the knowledge of British birds.

Possible breeding of the Green Sandpiper in Breconshire.—I have already reported to *The Field* the occurrence of two green sandpipers, during the spring and summer months, near here up to August, and from their actions suspected that they were breeding. I saw them constantly during the spring up to the end of June. I did not see them again until July 21st, although they have been noticed by others; but when following the otter hounds on that day they disturbed four together, about a mile higher up the river than the spot where the old birds used to frequent. They were very wild and flew high, but they may have been frightened by the otter hounds. Shortly afterwards, what I imagined were the old birds flew up the river close in front of us. Taking the above into consideration, it appears to me very probable that the green sandpiper has bred with us this summer, although I have no positive proof of it. Since writing the above a little party of six green sandpipers were observed daily, probably the four young ones and the two old ones. They stayed until the middle of August, when they left. The inference as to their having bred here is, I think, fairly plain.—E. Cambridge Phillips, Bwlch, Breconshire.

"Save me from my Artist."—The three pictures at page 300 of the "Encyclopædia of Sport," reproduced from the *Art Journal* for September, 1882, are, or were when they left the hands of my friend the photographer and the present writer, who stood by consenting at their production, admirable representations of the decoy, but the after treatment by the "artist" has made two of them absurd. One picture represents the "end of a pipe," and the decoyman is seen removing the tunnel-net which forms the final receptacle for the fowl. The first hoop of this net drops into a groove at the end of the fixed pipe, and when the birds are driven in, it is simply detached by raising the hoop and giving it a half turn, thereby securing the fowl, which are then removed one by one by the decoyman, and killed. It will be noticed that the artist has introduced a number of ducks (which, by the bye, in their frantic efforts to escape must have a very disturbing influence upon the fowl left in the pond), but unfortunately only one of their number has passed into the purse-net, the removal of which would set the remainder free! This is really too gross a libel on the skilled decoyman whose portrait is given. Of the very artistic introduction of the dog in the picture of the "mouth of a pipe," I will only say that the best thing which could happen to a decoyman's dog so far forgetting itself, and shamefully abusing its training, would be a speedy and painless death. It is needless to say that the letterpress which accompanies the illustrations, being from the pen of Mr. Harting, is free from the absurdities which usually disfigure such articles; but I doubt not, on seeing the illustrations, he would exclaim, as many another author has had good reason to do, "Save me from my artist."—Thomas Southwell, Norwich.

Herons catching Trout.—A heron shot some time ago at the Solway Fishery had twenty-seven yearling trout in his crop—a goodly number surely for one meal! Another, shot on another occasion, contained twenty-five. I have often watched the birds when engaged in robbing the ponds, and have seen one under such circumstances put itself into almost every conceivable position; running excitedly to and fro, with outstretched neck, beholding thousands of yearling trout in the clear water of a pond close by, and suggesting a good deal of the ludicrous. The trout are just out of his reach, but he can see them, and one rising to the surface now and then, almost within his reach, seems to send him half frantic. At last his "plan of campaign" is settled, and slipping over the bank of the pond—which is about one foot perpendicular above the water, and grown over with grass—he grasps the grass, or anything he can lay hold of, with one foot (which is doubled up, the tarsus being in a horizontal position, or nearly so), and with the other leg in the water, and stretched to the full, he gains a footing if he can. One wing is folded to his body, or may be drooping a little, whilst the other is outstretched over the bank, and is used as an arm for holding on. The breast of the bird is in the water, and there he remains motionless, with his beak very near the surface, though the head is drawn back a little. With thousands of fish near he has not long to wait before one comes within his reach, and dexterously, with his head well submerged, he seizes his luckless victim, losing his balance in doing so. But never mind! the capture has been made, and the heron calmly swims across the pond some thirty feet and flaps out on the other side. Twice have I now witnessed this interesting performance. One morning I was waiting during the early hours to shoot a heron; the bird came and alighted by a pond full of yearlings. The water was quite clear, and he could see the fish, but owing to the vegetation on the banks of the pond, he could not slip over the edge in the manner already described. He ran about wildly, reminding me of a terrier who can see or smell a rat that his teeth cannot quite reach. The bird was wildly excited, and soon settled on his plan of action. He flapped over the water, stopped, hovered a moment, and then dropped in bodily, his beak being right down among the fish, one of which he brought up. This is not hereditary instinct, but it is an acquired habit, which is developed by force of circumstances.—J. J. Armistead, Solway Fishery, Dumfries.

Herring Gulls and Guillemot.—When residing at Filey, in June, we often found eggs of the common guillemot, fresh and *entire*, washed up on the coast. I was told that the cliff-climbers of Speeton and Bempton complain greatly of the injury done by the Herring gulls in carrying off the eggs of the guillemot from the cliffs. This they do *in their feet*, and if alarmed, or through carelessness, frequently drop them into the sea, where they at once sink, and are subsequently washed up in Filey Bay. I have long known that Herring gulls will carry off large eggs impaled on their powerful beaks, but the fact of their using the feet is new to me. The only parallel I can find is the statement of Dr. Hayes ("Open Polar Sea") when he says: "I have seen the ivory gull seize our wounded auks, and, after a sharp battle. carry them off in her talons—a novel use of a palmated foot."—John Cordeaux, Great Coates, Lincoln.

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Greenshanks and Barred Warbler in Norfolk.—Finding myself now at an inconvenient distance from my old haunt on the Yorkshire coast, I have been trying a Norfolk hunting-ground between August 23rd and September 3rd of this year. Amongst the *Limicolæ*, the great feature was the number of greenshanks to be met with; usually seen in my previous experience by ones and twos, it was nothing unusual to see them in parties of four and five individuals, and probably a score or five-and-twenty in all were a not unusual day's experience. Of migrant strangers I saw but few, though these were interesting. This scarcity was no doubt due to the persistent south-west winds, which I have never found to be very fruitful in Continental migrants. On May 27th I had the pleasure of picking up the sixth British example of the barred warbler, which dodged out of a small bush in a high wind, and gave me a snap shot over a sandhill. Till I picked it up I believed it to be a garden warbler, as I did the one I obtained in almost exactly similar circumstances in Yorkshire on August 28th, 1884. This year's one is an adult female.—Henry H. Slater, Wansford.

White Stork at Horsham, Sussex.—On August 18th last a fine male specimen of the white stork (*Ciconia alba*), an irregular visitor to Great Britain, was picked up dead on New Barn Farm, Colgate, about four miles north-east of Horsham. It was found to have been shot, but must have escaped from the gunner only to die of its wounds. It has been preserved by Mr. A. Richardson, of Park Street, Horsham, where it can now be inspected.—Chas. J. Marten, Horsham.

Albatross in Cambridgeshire.—Colonel E. A. Butler records the capture of an albatross—which has been identified by Messrs. Howard Saunders, Osbert Salvin, and J. H. Gurney, as *Diomedea melanophrys*—near Linton, in Cambridgeshire, on July 9th, 1897. (*The Field*, Vol. XC., August 28th, 1897.)

The Discovery of Bones of the Great Auk in County Waterford by R. J Ussher.—These bones are of at least two distinct examples of *Alca impennis*, and were determined by Prof. Newton and Dr Gadow. They were discovered by Mr. Ussher in a kitchen midden, as far south as 52° north latitude. (*Irish Naturalist*, Vol. VI., No. 8, p 208.)

The Autumn Song of Birds, by O. V. Aplin, M.B.O.U., is a continuation of a discussion between the author and C. A. Witchell on the autumn songs of the robin, starling, thrush, blackbird, willow wren, chiffchaff, blackcap, and other birds. (*The Zoologist*, 4th Series, Vol. I., No. 9, pp. 410 and 411.)

All contributions to the column, either in the way of notes or photographs, should be forwarded to Harry F. Witherby, *at 1, Eliot Place, Blackheath, Kent.*

Science Notes.

It is reported that the Southern Mahratta Railway offers free passes to all observers of the total eclipse of the sun on 22nd January, 1898. Sir Norman Lockyer and Mr. Fowler will, we understand, be stationed near Ratnagiri, on the Bombay coast, while the Astronomer Royal, Prof. Turner, and Dr. Common will take up a position where the shadow track crosses a point on the Great Indian Peninsular Railway. The length of the path across India is about a thousand miles, and the width of the shadow fifty miles, so that, considering the climatic condition of India, favourable opportunities for utilizing the precious *two minutes* may be expected.

Prof. Schaeberle is credited with having noticed a partial division in the inner bright ring of Saturn, which, of course, can only be detected under the most favourable seeing conditions.

Sir George Grove draws attention to two passages in the songs in Shakespeare's plays in which he appears to have intended to imitate the effect of the note of the thrush. The passages which Sir George Grove imagines not to have been much noticed in this regard are :—1. Stanza 3 of Autolycus's song in "A Winter's Tale" (Act IV., Scene 3): "With heigh! with heigh! the thrush and the jay." 2. Amiens' song in "As You Like It" (Act II., Scene 5): "Come hither! come hither! come hither!" In the first instance the repetition of "with heigh," and, in the second instance, the thrice repeated "come hither, come hither, come hither," each foot being sharply accented on the second syllable, give the exact effect of the short phrases which are so noticeable in the thrush's song, and which Lord Tennyson has given so well (though more elaborately than Shakespeare) in his poem "The Throstle": "I know it, I know it, I know it"—and several other lines. It is a pleasure to find these two great poets agreeing—apparently unintentionally—on such a small but worthy point in nature.

Prof. Goldstein, of Berlin, has succeeded in experimentally reproducing, by means of cathode rays, certain very distinct and characteristic cometic phenomena, such as the radiation of light from the head of a comet and the resultant development of a tail. He has also been able, by these means, to account for certain peculiarities of this class of phenomena which have been observed in recent years.

According to Dr. Spencer and Prof. Gilbert, the surface of the earth near the Great Lakes of North America is sinking at the rate of about one inch in ten years, a subsidence which, in the course of a few centuries, will place Chicago and Detroit under water; within a thousand years Lake Michigan will flow freely into the Mississippi, and in three thousand years Niagara will be dry.

Referring to the insect-digesting powers of pitcher-plants, Mr. Burbidge, Curator of the Botanical Gardens at Trinity College, Dublin, suggests that nature had prompted that means of obtaining nourishment in order to compensate for the disadvantages attaching to a feeble root-system.

Dr. Peate has completed the process of grinding and polishing his gigantic disc of glass, over sixty-one inches in diameter, on which he has been engaged more than two years. By the aid of this mirror a hair can be seen at a distance of a thousand feet, and the reflection of the moon at the focal point would be absolutely blinding.

Sir William Flower, writing from Cromer to the *Times* on 4th September, describes a waterspout, eight miles from shore, consisting of a cloud with a narrow stem which rose from the sea, and a long conical projection from the edge of a dense black cloud. This projection always pointed to the centre of the ascending cloud. The phenomenon was visible for about half an hour.

A discovery of ancient coins quite recently made in the neighbourhood of Kalisch, in Russian Poland, should prove interesting to numismatists. An earthenware vessel was accidentally unearthed in a wooded part of the estate of Bronczyr, containing coins dating from the tenth and eleventh centuries. There are splendid specimens of the silver currencies of Henry of Bavaria; of the English monarchs, Canute and Ethelred; of Boleslaf I., Boleslaf II., and Boleslaf III., of Bohemia; and of the Emperor Otto. Besides the coins, the vessel contained some eight pounds

weight of ancient silver *bijouterie*, some of which is evidently of ancient Arabic workmanship. It would seem a pity that the English coins of Canute and Ethelred should go to the numismatic collection in the Ermitage at St. Petersburg, instead of to the British Museum.

COMING COLD.

By Alex. B. MacDowall, M.A.

To a practical mind the small amount of insight hitherto gained into coming weather, may well appear a somewhat meagre result of the immense industry that has been expended in observation and study of the weather. We receive, with mild thankfulness, the small mercy of a daily weather forecast that comes with our morning paper. But there is probably no competent meteorologist in this country who will undertake to say what weather we shall have next week, or month, or winter, or year. If anyone were to apply at head-quarters in Westminster for enlightenment on such points, he might come away, I suspect, thinking of that line in the "Biglow Papers":—

> "Never say nuthin' that you can be held to."

We are offered, indeed, from time to time, a complete daily weather programme for a whole year. Somehow, we do not find ourselves very eager to shape our conduct by these remarkable instructions.

The science of meteorology is still in its youth, and we may with reason hope for considerable advance in future beyond the point now reached. If we ever attain to a method of long weather forecasts, we may be sure it will only be after many attempts, and many failures; just as will be the case if we ever reach the North Pole or learn to fly. By all means (we should say) let such attempts be made. And if we must occasionally smile when some ardent meteorologist "comes a cropper," let us remember, and hope, that he may do better next time!

Taking a wide survey, there are not wanting signs that progress is being made. Some instances may here be given.

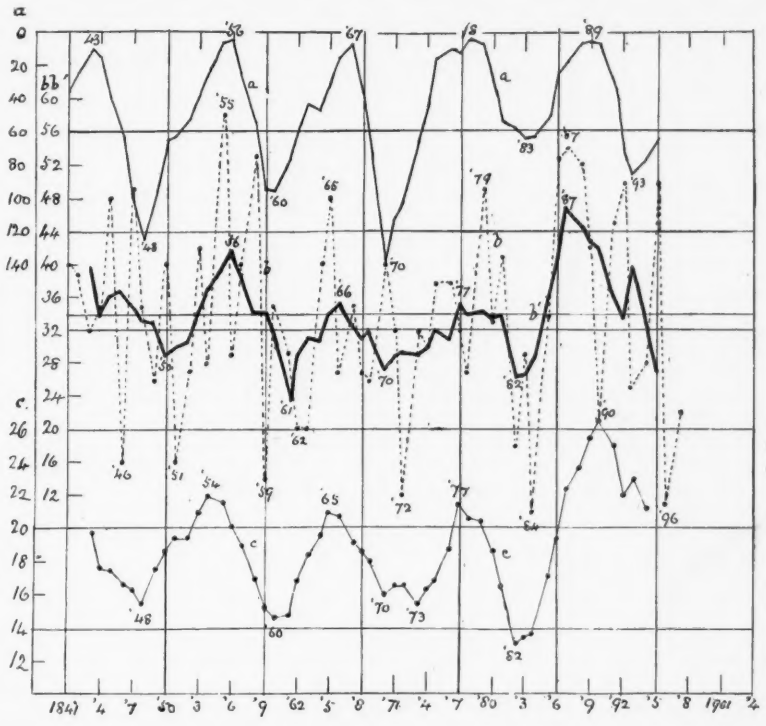
The able officials of the Indian Meteorological Service now find themselves in a position to issue, early in June, a useful forecast of the summer or south-west monsoon; being guided by a consideration of various factors—the strength of the south-east trades, the snowfall in the previous winter, etc. Details of this interesting achievement will be found in *Nature* of 26th November, 1896.

From a recent paper contributed to the *Meteorologische Zeitschrift* it would appear that in Hungary Herr Friesenhof has attained considerable success in forecasting the weather of that country about a fortnight in advance. He finds that on certain days, determined chiefly by positions of the moon, the barometric configuration over Europe is peculiarly liable to change.

The weather in India is of course much more regular than ours. And Hungary is rather off the course of those numerous depressions by which the weather of Western Europe is largely determined.

Dr. Maurer, of Zurich, has still more recently (*Meteorologische Zeitschrift*, July, 1897) shown reason for expecting that about the beginning of next century we shall be entering upon one of those warm periods whose centres, according to Brueckner, recur at about thirty-five years' intervals (cold periods intervening); so that we may then (in Western Europe) look for a series of warm and very warm summers, with, occasionally, very mild winters.

It is obviously in past experience that we must search for a clue to the character of weather that is to come, and I propose now to ask whether the records of winter cold, at Greenwich, throw any light on coming cold. We may roughly measure cold by the number of frost days, and



we shall confine our attention to the number of those in the first quarter of the year. (We might have taken the total number in the year, or some other portion, with similar, though perhaps less definite, results.)

About the middle of the diagram herewith will be seen a number of dots joined by dotted lines (*b*). This is the curve of variation of the number of frost days in the first quarter since 1841. In the smoothed thick line curve traversing it (*b'*) each year point represents an average of *five* of the values dealt with.

Above these curves is a curve of sunspots *inverted* (that is, the low points represent many spots, the high points few spots); and when we compare it with the smoothed curve of frost days, we find considerable correspondence, the crests of the latter coming near (sometimes rather *before*) minima of sunspots, and the hollows near (sometimes rather *after*) maxima of sunspots.

If, in a similar way, we draw a curve of the number of

days of northerly wind in the first quarter (the days of wind being classified according to the four cardinal points), and smooth it with averages of five, we have the curve marked *c*, which has a generally similar course to the smoothed curve of frost days.

Now, the method of smoothing curves, which is largely resorted to in meteorology, appears to be regarded suspiciously by some minds, as a sort of "cooking" of statistics. Let us then put aside these curves for a little, and take a different point of view.

Consider the following five-year groups: the year just before each *minimum* of sunspots, and two years on either side. Were the first quarters in those years severe (+) or mild (—), (referring to an average)? The following table supplies an answer:—*

				Min.			Algebraic sum of Differences.
1841-44		+	+	—	+	...	+ 10
1853-57	+	—	+	—	+	...	+ 27
1864-68	+	+	—	+	—	...	+ 7
1875-79	+	+	—	—	+	...	+ 4
1886-90	+	+	+	+	—	...	+ 52

Thus we find sixteen of those quarters *severe*, and only eight *mild*; also a preponderance of plus signs in each five-year group, and an excess in each of the algebraic sums.

Consider next these five-year groups: the year just *after* each maximum of sunspots, and two years on either side. What kind of first quarters occurred in those years?

				Max.			Algebraic sum of Differences.
1847-51	+	+	—	+	—	...	— 4
1859-63	—	+	—	—	—	...	— 52
1869-73	—	+	—	—	—	...	— 28
1882-86	—	—	—	av.	+	...	— 26
1892-96	+	—	—	+	—	...	— 6

In this case we have sixteen of those first quarters *mild*, eight *severe*, and one average; further, a preponderance of minus signs in the five-year groups except one, and a deficit in each of the algebraic sums.

The reader is invited to study these facts and diagrams independently, and to estimate the probabilities involved.

It seems to the present writer that we are now about the beginning of another of those long waves of the smoothed curve of frost days, which may be expected to culminate near the next sunspot minimum. At what date may we look for that minimum? Taking the eleven years' period as our guide, about 1900; but the interval, it must be remembered, varies.

We might fairly, then, perhaps expect in the five-year group centred about that time (if a minimum), or rather before, a recurrence of the state of things indicated in the first of the above tables; speaking generally, a preponderance of cold (as measured by the number of frost days). And looking still further to the next maximum of sunspots, if that occurred about 1904, we should anticipate then a preponderance of mild weather, as in the second table.

As to the degree of excessive cold about this next sunspot minimum, one may hesitate to give an opinion; but the new wave seems at least likely to be lower than the last, and more of the order of the two previous. (In this connection it is instructive to consider the thirty-five years' period of weather demonstrated by Brueckner.)

Should these speculations appear to be too indefinite to be of much practical use, they may yet perhaps incite some readers to further inquiry into this interesting subject.

* The sunspot minimum years are 1843, 1856, 1867, 1878, 1889; the maximum years, 1848, 1860, 1870, 1883, 1893. In the first group of the first table the value for 1840 is not given, as the series commences with 1841.

ON THE VEGETATION AND SOME OF THE VEGETABLE PRODUCTIONS OF AUSTRAL-ASIA.—IV.

By W. Botting Hemsley, F.R.S., F.L.S.

Illustrated by Miss Ethel Walker.

In my last article I announced my intention of devoting my next to the singular and highly diversified family of plants known to botanists as the *Proteaceæ*. It is difficult to convey an idea of the aspect and peculiarities of this singular family, because familiar subjects for comparison are wanting, and I can only again recommend those persons in whom my articles may perchance have awakened some interest, to visit the temperate house, the Marianne North Gallery, and the museums at Kew, or the botanical department of the Natural History Museum at South Kensington, where living plants, paintings, or dried specimens are exhibited with more or less descriptive and explanatory labels; but, as comparatively few persons have opportunities of visiting these admirable and instructive national establishments, I will endeavour to impart some information with my pen, aided by a few figures.

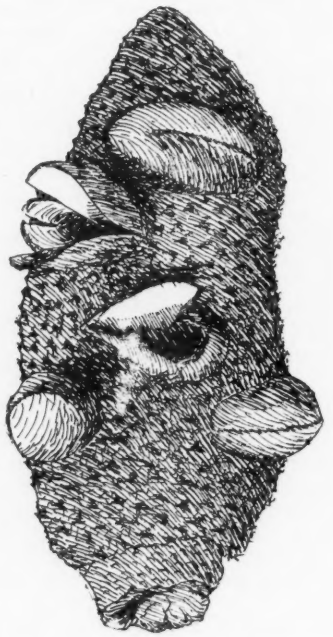


Fig. 1.—A Cone of a Species of *Banksia*, on which only a very few of the Flowers have given birth to Seed-vessels. Nearly natural size.

The *Proteaceæ*, with very few exceptions, are confined to the southern hemisphere, inhabiting Australasia, Africa, and America, but not extending to Polynesia proper. Altogether about a thousand species are known, and they are referred to fifty different genera; considerably more than half of them being restricted to Australia proper. Two are found in New Zealand; between thirty and forty in New Caledonia; about half a dozen in New Guinea; and one genus extends northward to South China and Japan. There is also a great concentration of *Proteaceæ* in South Africa, among them the famous silver tree, *Leucadendron argenteum*, a native of the Table Mountain; and a few stragglers reach as far north as the mountains of Abyssinia and Guinea. In America they are much less numerous, but there also a few species occur north of the Equator, as far as Central Mexico. The genera of each of the three areas—Australia, Africa, and America—are nearly all different, and all the species are different. Such is the present distribution of the *Proteaceæ*, and there is no convincing evidence that any member of this family inhabited the northern hemisphere in earlier geologic

periods; yet numerous fossil plants of the Eocene formation of Europe were formerly referred to about ten of the existing Australian genera.

Returning to Australia, we find that although there are *Proteaceæ* spread all over the country, from north to south and east to west, two-thirds of the six hundred species are concentrated in West Australia, and these chiefly in the extreme south-west. Moreover, less than a score of these four hundred species extend beyond the limits of that colony.

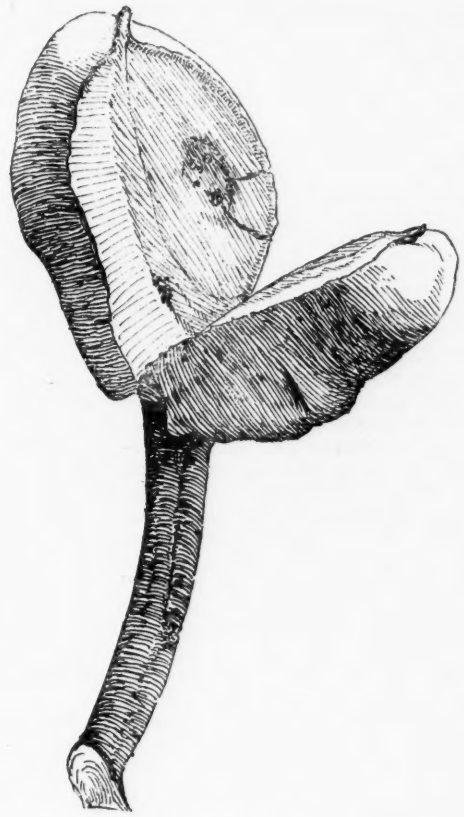


Fig. 2.—Open Seed-vessel of *Hakea crassifolia*. Slightly reduced from natural size.

The almost endless variety in habit, foliage, and flowers presented by these plants fully justifies the botanical designation of *Proteaceæ*. In the course of these articles I may have mentioned the fact that the same general appearance or aspect, the same kind of foliage, and very similar inflorescence, are repeated in the most distantly related families of flowering plants, so that in the absence of flowers or fruit it is often impossible to say to what family a given plant belongs without a microscopic examination of its anatomy—and this branch of botany is still in its infancy. Classification is almost entirely based on the structure of the flower, the seed, and seed-vessel or fruit, and gross mistakes have been made by botanists in naming plants from flowerless specimens. Instances are not wanting in the *Proteaceæ*, for I remember one which was originally described as a fern.

A very large proportion of the *Proteaceæ* are shrubby, varying from diminutive trailing plants to large bushes, like rhododendrons and laurels. A few attain the dimensions of large timber trees, and a few are almost herbaceous in character. Almost all have thick, hard leaves, which vary in size and shape to a surprising extent, and the same range and kind of variation is repeated in different genera. Often they are quite thick and woody, and they usually persist for many years. The leaves of one resemble a heath, of another an oak, of another a myrtle, of another a fern, of another furze, and of another a thistle. In many species, of various genera, the leaves are cylindrical, without any distinction of stalk and blade, and having a formidably sharp point. In some they are reduced to mere spines; in others they are more or less elongated and pliable. *Hakea lorea*, for example, has slender, whip-like leaves, often more than a yard long, and not more than a quarter of an inch thick.

Fig. 3.—One of the two Seeds from the Seed-vessel of *Hakea crassifolia*.

Coming to the flowers, we meet with equal diversity in size, shape, colouring, and arrangement, though the structure is fairly uniform. Bright colours are not uncommon, but several other families surpass the *Proteaceæ* in brilliancy and conspicuousness. Crimson and yellow are the prevailing colours, and green with a slight infusion of yellow is not infrequent. The disposition or arrangement of the flower is very striking in the genus *Banksia*, which is, perhaps, the most prominent of all the *Proteaceæ*—at least in certain districts, especially western, outside of the tropics. In this genus the flowers are crowded as thickly as they can stand in spherical, ovoid, oblong, or cylindrical cones; and as the axes of these cones do not elongate nor increase perceptibly in diameter, it follows that there is only space for a small number of the seed-vessels to attain full development. Indeed, out of five hundred to fifteen hundred flowers in a cone, comparatively few are fertile. In some of the species the individual seed-vessels are relatively large, and then only from a dozen to a score are developed. Fig. 1 represents a small cone in which five seed-vessels are visible. Each one resembles a bivalve shell inserted horizontally; and under certain meteorological conditions the dense woody valves open and permit the seeds to escape. In some of the larger species the cones are from nine to twelve inches long and from three to four in thickness. A peculiarity of these and many other Australian trees and shrubs is the presence of many generations of seed-vessels at the same time. This phenomenon may sometimes be observed in other countries, but in Australia it is common.

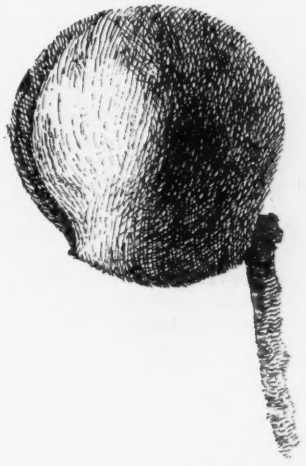


Fig. 4.—Seed-vessel or Fruit of *Grevillea gibbosa*, beginning to open. About four-fifths of the natural size.

It is hardly necessary to explain that the genus *Banksia*

was named after Sir Joseph Banks, whose part in the botanical exploration of Australia I have already mentioned. He brought home specimens (which are in the British Museum) of four species from New South Wales and Queensland, and they were described by the younger Linnæus in 1781. Since then upwards of forty other species have been discovered, more than thirty of them in West Australia. Quite recently one of the original four, *B. dentata*, was collected in New Guinea; with this exception, the genus is, so far as we know, peculiar to Australia. In 1788 Messrs. Lee and Kennedy, famous nurserymen of Hammersmith, obtained seeds of a number of plants from Botany Bay, and it is recorded that the seed of *Banksia serrata* was the very first to germinate. It flowered about ten years later, and was figured in Andrews's "Botanist's Repository."

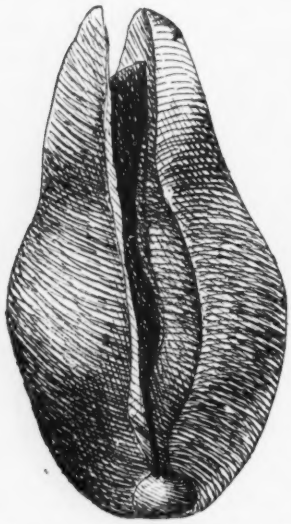


Fig. 5.—Seed-vessel or Fruit of the Australian Wooden Pear. About four-fifths of natural size.

The individual flowers of the *Banksiæ*, and indeed of many other *Proteaceæ*, bear some resemblance to our honeysuckles, having recurved petals, and they also secrete honey abundantly; hence the early settlers applied the name "honeysuckle" to the genus.

An allied genus, *Dryandra*, comprising about fifty species, quite restricted to West Australia, differs in having the usually smaller heads of flowers surrounded by a ring of so-called bracts, or modified leaves; and as they usually have divided prickly leaves they may be likened to shrubby thistles.

The accompanying illustrations represent some other kinds of proteaceous seed-vessels and their seeds. *Hakea crassifolia* (Figs. 2 and 3) is a very remarkable one indeed. The hard woody valves are nearly an inch in thickness, and before the mechanism of the contractile tissue comes into action to open them, they can only be separated by cutting or by the employment of great force. The seed-vessel usually contains two flattened seeds, face to face. The central part of the seed, containing the embryo of the future plant, is not much thicker than a sixpenny-piece, smooth on the surface next the other seed, and furnished on the outer surface with prickles, which fit into corresponding depressions in the woody fruit. Surrounding the central nucleus of the seed is a wing-like expansion of tissue of extreme thinness, difficult to represent in a drawing. The shrub bearing this seed-vessel is a native of the sandy plains skirting the Kalgan River, in West Australia; and the genus *Hakea*, which is a large one, exhibits nearly as wide a range of variety as *Eucalyptus*.

Fig. 4 is an example of the seed-vessel of a Queensland species of the allied and still larger genus *Grevillea*. It strongly resembles a bivalve shell, and the seed is circular with a marginal wing.

The "wooden pear," *Xylomelum pyriforme* (Fig. 5), gained its colonial name from its shape and consistence, though it should be noted that it tapers upwards instead of downwards. There are four recognized species, the one figured being a native of New South Wales, a second of Queensland, and two of West Australia; but they do not differ widely from each other. It will be seen that the seed has a terminal wing or membrane instead of a circular one, and that the whole seed bears a strong resemblance to one of the halves of a fruit of the sycamore or maple.

It is probable that some readers of the foregoing notes have read other popular accounts of the fruits of Australia in which we are told that the Australian pear is wooden, and that the Australian cherry has the stone outside. I have shown that the former is a fanciful name; and of the latter (*Exocarpus*) I may add that the fruit is a small stone with a thin skin over it, and the stalk on which it is borne is more or less fleshy; but the whole thing is very small as compared to a cherry.

With regard to the economic value of the *Proteaceæ*, there is not much to say. Few attain what may be called a timber size, but the wood of a considerable number makes ornamental furniture, and that of others is useful and highly valued for agricultural and other purposes. The bark of some species of *Banksia* is occasionally used for tanning. Resin or gum resin is yielded by various members of the family, but its value has not been established. As food plants they rank very low. Though honey is produced in abundance, and greedily sucked by the aborigines and children, a reliable authority states that he never resorted to it except in cases of extreme thirst, because it invariably caused headache. The seeds of many species are eaten by the aborigines in times of need, and the Queensland nut, *Macadamia ternifolia*, "is of excellent flavour, and relished alike by aborigines and Europeans, and is always eagerly bought." Some that I have had in my own possession for upwards of fifteen years are still sound and sweet. The tree bearing this nut is regarded as of so much importance to the aborigines that "timber getters" on the Government lands are not allowed to fell it. The entire globular fruit consists of an outer fleshy or leathery coat followed by a thick hard shell enclosing the seed or kernel, which is about the size of a large hazel nut.

Fig. 6.—A Seed of the Wooden Pear.

Of course, it is quite possible that future investigations may bring to light more valuable products in this singular family, and also means of more profitably utilizing some of those as yet imperfectly known.

South African *Proteaceæ* were cultivated in Europe as early as, if not earlier than, the beginning of the eighteenth century. Boerhaave ("Index Alter Plantarum quæ in Horto Academico Lugduno-Batavo aluntur, 1720") figures about twenty-five species of *Protea* and *Leucadendron* cultivated in the Leyden Botanic Garden, under such extraordinarily long names as *Lepidocarpodendron* and *Hypophyllocarpodendron!*

THE PEDIGREE OF THE DOG.

By R. Lydekker, F.R.S.

THE number of breeds and varieties of the domesticated dog is so great that it is at first rather hard to believe that all are descended from a few wild types. Nevertheless, the differences between these are not greater than those met with among domesticated pigeons and fowls, which are known to

be respectively descended from the wild pigeons of Europe and the jungle fowls of Asia. A peculiarity of most domestic dogs is their power of barking, which, according to the late Mr. A. D. Bartlett, is entirely unknown among all wild members of the family *Canidæ*. And even the semi-domesticated dogs of the Eskimo are unable to bark, as are the dingos of Australia; but if kept among barking dogs, both these breeds, and apparently also wolves and jackals, will soon learn to bark in a more or less thorough manner. Barking is, therefore, evidently an acquired habit; but that it affords no argument against the derivation of the domesticated breeds from the wild races is evident not only from the above instance, but also from the circumstance that the Asiatic jungle fowl are quite unable to crow in the manner characteristic of their domesticated descendants. Several traits—such as turning round several times on a hearthrug in order to make a hole before lying down, and scratching up earth with their fore feet and throwing it backwards with the hind pair—common to wolves and jackals, are inherited by even the most domesticated of domestic dogs; and these are evidently of great value in helping to trace the ancestry. A German writer, the late Prof. L. Fitzinger, considered that domestic dogs might be divided into seven well-marked groups, which included close upon a couple of hundred of more or less well-marked breeds and varieties. Other authorities are, however, of opinion that the number of main groups might be reduced to half a dozen, these including wolf-like dogs, such as the Eskimo breed, the various kinds of greyhounds, spaniels, hounds, mastiffs, and lastly terriers.

All who have written on the subject are in accord in regarding all domesticated dogs, with the exception of the Australian dingo, as constituting but a single species—the *Canis familiaris* of Linnæus. But if it be true, as seems probably the case, that domesticated dogs trace their ancestry to more than a single wild species, it will be obvious that *Canis familiaris* cannot in any sense be regarded as equivalent to an ordinary wild species; and that, properly speaking, if this were possible, the various tame breeds ought to be affiliated to the wild species from which they are respectively derived. Still, for practical purposes, the ordinary classification may be accepted, if it be remembered that *Canis familiaris*, like *Felis domestica*, is in all probability a "convergent" species.

By naturalists all the members of the dog tribe are included in the great family *Canidæ*, which thus embraces wolves, jackals, foxes, wild dogs, the African hunting-dog, the long-eared fox of the Cape, and the bush-dog of Guiana. Somewhat different views are entertained as to how many of these should be included in the typical genus *Canis*, but this is a matter which needs no consideration here, and we may accordingly proceed to eliminate from the list those groups which have certainly no claim to be on the ancestral line of the domesticated breeds.

First of all we may dismiss the rare South American bush-dog (*Speothos*), which is a small somewhat fox-like creature, with a short tail, and teeth of a quite peculiar type. Equally far removed from the line are the long-eared Cape fox (*Otocyon*) and the African hunting-dog (*Lycaon*), the former having more teeth than the domesticated breeds, while the latter has fewer toes. Next we may eliminate the wild dogs of Asia, which are frequently separated from the other members of the family under the name of *Cyon*, as all these have one pair less of molar teeth in the lower jaw, and therefore obviously cannot be the ancestral stock, as an organ once lost cannot be replaced. Somewhat nearer to the domesticated races are the foxes and fennecs (*Vulpes*), exclusive of the South American species commonly so called; but if we examine the skull of the British or any other species of true fox, an important difference will be found between it and the skull of any domesticated dog, wolf, or jackal. The difference is best displayed in the shape of the projecting process of bone forming the hinder border of the socket of the eye; this process in a fox being distinctly concave, whereas in all the others it is highly convex.

We thus arrive at the conclusion that the only existing members of the family that can possibly be the ancestors of the domesticated breeds are wolves, jackals, the Australian dingo, and certain South American species which, although commonly termed foxes, are really more closely allied to the jackals and wolves; and it is further obvious that the only extinct species which can claim a place in the line of descent are those having skulls and teeth of the wolf type—in other words, species of the genus *Canis* in its restricted sense.

Before proceeding further, it may be mentioned in confirmation of the foregoing views that in all Mr. Bartlett's long experience at the "Zoo" he never met with a well-authenticated instance of a fox interbreeding with either a dog, wolf, or jackal; and although newspaper reports have subsequently mentioned a hybrid between a fox and a dog, it is obvious that such crosses are, at the most, of extreme rarity.

On the other hand, when suitably matched, there is no sort of difficulty in obtaining crosses between wolves and jackals and domesticated dogs; and it is a well-known fact that the Eskimo are constantly in the habit of crossing their sledge-dogs with wolves in order to impart strength and stamina to the breed. Indeed, Eskimo dogs are so closely related to wolves that there can be no question that they are descended from them, Mr. Bartlett remarking that they are undoubtedly "reclaimed or domesticated wolves."

This being so, Eskimo dogs should properly be called *Canis lupus* instead of *Canis familiaris*; and if it could be shown that all domesticated dogs have the same ancestor, the former name should stand for all. On the other hand, as was long since pointed out by that acute observer the late Sir John Richardson, the Hare Indians of North America, who inhabit a zone lying considerably to the south of Eskimo territory, have dogs very closely resembling the small American prairie-wolf, or coyotè, which is the wild species most commonly met with in their territory. And it may be affirmed with a considerable degree of confidence that the Hare Indian dog presents the same relationship to the coyotè as is borne by the Eskimo dog to the wolf. Accordingly, if we base our nomenclature on descent, the former breed ought to be called *Canis latrans*.

We have now arrived at the conclusion that domestic dogs trace their descent back to at least two wild species, and we may quote once more from Mr. Bartlett, who writes as follows:—"All wolves, if taken young and reared by man, are tame, playful, and exhibit a fondness for those who feed and attend to them. The same may be said for all the species of jackals. This being so, it is highly probable that both wolves and jackals were for many ages in the company of man, and that owing to this association the different species of these animals may have bred together and become domesticated."

This introduces the various species of jackals into the problem; and since there is a decided similarity between certain domesticated breeds of dogs and jackals, while the native domestic dogs of nearly every country present a more or less markedly striking likeness to one or other of

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the indigenous wild *Canidæ* of the same district, there can be little doubt that *Canis familiaris* has a multiple origin, and that man has tamed various wild races at different times in different parts of the globe. And it will be obvious that where the domestication has taken place in very remote ages, and there has been much subsequent mingling and shifting of population, the resemblance to the wild race will be the least marked. On the other hand, where the taming has been comparatively recent, where there has been no shifting of population, or where the original breed was best adapted to the needs of its masters, then the resemblance to the original stock will be most likely to persist longest.

To give a few instances. The late Edward Blyth was much struck with the marked resemblance between many of the Indian pariah dogs and the wolf of the same country —a resemblance to which I can testify from my own experience. In many parts of Europe the wolf-dogs and sheep-dogs are remarkably like the races of wolves inhabiting the same districts; and the black Florida wolf-dog is strikingly similar to the black wolf of that country. Sheep-dogs may therefore be included among the breeds which are descended from wolves, and are some of those which have undergone the least amount of modification from the parent type. On the other hand, when we proceed to South-Eastern Europe and the South of Asia, we meet with breeds of dogs so like the jackals of the same districts that it is hard to believe they are not very closely related. South Africa is the home of that very peculiar species the black-backed jackal, and in many districts dogs are to be met with showing a marked resemblance in form and coloration to that species, although having lost the deep black patch on the back from which it takes its name. It has also been noticed that certain domesticated breeds in South America are so like the *Canis azaræ* of the same region as to lead to the belief that the one is the descendant of the other.

From these and other considerations Darwin was led to the following conclusion :—"It is highly probable that the domestic dogs of the world are descended from two well-defined species of wolf, namely, *C. lupus* and *C. latrans*, and from two or three other doubtful species, namely, the European, Indian, and North African wolves; from at least one or two South American canine species; from several races or species of jackal; and perhaps from one or more extinct species."

In all the above-mentioned instances the domesticated breeds belong either to half-savage races, or are those which, like wolf-dogs, sheep-dogs, and pariah dogs, have departed but little from the original wolf or jackal type. In some cases we have seen these breeds are kept true by crossing with the original stock, and several of them may be comparatively modern. Such breeds throw no light on the origin of the more specialized domesticated varieties, such as mastiffs, spaniels, hounds, and terriers, all of which are quite unlike any wild species, and have evidently undergone a long course of modification, dating back in some cases for hundreds if not thousands of years. To trace the pedigree of such breeds is probably quite impossible, although the investigations of archæologists and palæontologists are most important in proving the extreme antiquity of the domestication of the dog. Ancient monuments show that at a very early period domestic dogs were differentiated into two very distinct breeds, namely, those which hunt by scent like hounds, and those which, like greyhounds, depend upon sight in the chase; and when once these were established further modifications would doubtless have soon arisen if attention was paid to breeding. Many of these breeds and varieties were doubtless produced by crossing those derived from different wild species, by which means all trace of the original ancestry would gradually have been lost.

In the Roman period not only were sight-hounds and scent-hounds fully differentiated, but there were also various kinds of lapdogs and house-dogs, although none quite like our modern breeds. Even as far back as about 3000 B.C. Egyptian frescoes show not only greyhound-like breeds, but one with drooping ears like a hound, and a third which has been compared to the modern turnspit; while house-dogs and lapdogs came in soon afterwards. Whether any of these are the direct ancestors of modern breeds, or whether all such have been produced by subsequent crossing, is a very difficult question to answer, more especially when we recollect that if an ancient Egyptian artist had to draw the portrait of a modern dog it would be very doubtful whether it would be recognized by its master or mistress.

But the record of the antiquity of domesticated dogs does not even stop with the earliest known Egyptian monuments. Not only were such breeds known in Europe during the iron and bronze ages, but also during the antecedent Neolithic or polished stone period. These have been described by Profs. Rütimeyer and Wöldrich, and those who are acquainted with the difficulty of distinguishing between some of the living species by their skulls alone will understand the laborious nature of the task. Still these authorities appear to have made out that the Swiss Neolithic dog (*Canis palustris*) had certain cranial resemblances to both hounds and spaniels, and thus indicated an advanced type, which is considered to have been derived from neither wolves nor jackals, but from some species now extinct. Two other breeds have also been recognized from the superficial deposits of the Continent; and if, as is very likely to be the case, any or all of these races are the forerunners of some of the modern breeds, it will readily be understood how complex is the origin of the mixed group which we now call *Canis familiaris*. Even in South America there is evidence of the great antiquity of domestic dogs, for I have described a skull from the superficial deposits of Buenos Aires which, though apparently contemporaneous with many of the wonderful extinct mammals of the Pampas, yet shows unmistakable signs of affinity with domesticated breeds, although the precise relationship has not yet been established.

Perhaps, however, the greatest puzzle in the group is the dingo, or native dog of Australia, which has been regarded as a distinct species, under the name of *Canis dingo*, and is found both in the wild condition and also in a semi-domesticated state among the natives. In appearance it is somewhat like a rather small wolf, with pointed ears and a bushy tail; its usual colour being rufous tawny, although some individuals are much paler, and others so much darker as to be almost black. There are at the present time a couple of specimens living in the "Zoo," so that many of those of our readers who are so disposed have an opportunity of seeing it for themselves.

Since, with the exception of numerous peculiar kinds of rats and mice and a few bats, Australia is populated with marsupials to the exclusion of ordinary mammals, it was long supposed that the dingo was introduced by man. But of late years a quantity of its fossilized remains have been dug up in various parts of Australia in association with those of gigantic kangaroos, diprotodons, and other extinct marsupials, in beds where there appears to be no evidence of the presence of man. And it has consequently been urged that the dingo is as

truly indigenous to Australia as are kangaroos and wombats. There is, however, great difficulty in accepting this view, as the rodents might have obtained an entrance by being carried on floating wood, or by some other means of transport; and if the dingo travelled by land to Australia other placental mammals ought to have accompanied it. Moreover, the dingo is neither a wolf nor a jackal, but in all essential characters a true dog of the domestic type, which seems scarcely separable from *Canis familiaris*. We have, therefore, the further difficulty of determining, if it be really a distinct species, from what Asiatic form it took its origin. This difficulty is enhanced when we recollect that throughout the Malayan countries there are no wild species of the restricted genus *Canis* known, the so-called wild dogs of Java and Sumatra belonging, as already said, to *Cyon*. It is true that Messrs. Kohlbrugge and Jentink have recently described a dog from the Tengger Mountains in Eastern Java under the name of *Canis familiaris tenggerana*, which is apparently a semi-domesticated race living in a partially wild condition. When more is known about it, and its resemblances or dissimilarities to the dingo are fully indicated, there may be a possibility of some rays of light being shed upon the problem of the introduction of that animal into the Antipodes.

THE FACE OF THE SKY FOR OCTOBER.

By Herbert Sadler, F.R.A.S.

SOME singularly fine sunspots and groups have been visible of late.

Conveniently observable minima of Algol occur at 11h. 21m. P.M. on the **23rd**, and at 8h. 12m. P.M. on the **26th**.

Mercury is a morning star, and is well situated for observation during the first three weeks of the month. On the **1st** he rises at 4h. 38m. A.M., with a northern declination of 2° 37′, and an apparent diameter of 8″. He is at his greatest western elongation (18°) on the **7th**. On the **8th** he rises at 4h. 28m. A.M., with a northern declination of 2° 26′, and an apparent diameter of 6¾″. On the **15th** he rises at 4h. 52m. A.M., with a southern declination of 0° 55′, and an apparent diameter of 6″. On the **22nd** he rises at 5h. 31m. A.M., with a southern declination of 5° 38′, and an apparent diameter of 5¼″. After this he approaches the Sun too closely to be conveniently observed. He is in conjunction with Jupiter in broad daylight on the morning of the **6th**. While visible he describes a direct path in Virgo.

Venus is a morning star, and is well situated for observation. On the **1st** she rises at 2h. 53m. A.M., with a northern declination of 10° 16′, and an apparent diameter of 12¾″. On the **8th** she rises at 3h. 14m. A.M., with a northern declination of 7° 17′, and an apparent diameter of 12½″. On the **15th** she rises at 3h. 34m. A.M., with a northern declination of 4° 7′, and an apparent diameter of 12″, nearly nine-tenths of the disc being illuminated. On the **22nd** she rises at 3h. 55m. A.M., with a northern declination of 0° 50′, and an apparent diameter of 11¾″. On the **31st** she rises at 4h. 24m. A.M., with a southern declination of 3° 29′, and an apparent diameter of 11½″. During the month she describes a direct path through the eastern portion of Leo into Virgo. She is in conjunction with Jupiter on the **19th**.

Mars is too near the Sun to be conveniently observed, as are also Saturn and Uranus, while we defer an ephemeris of Jupiter till November.

Neptune is an evening star, rising on the **1st** at 8h. 36m. P.M., with a northern declination of 21° 52′, and an apparent diameter of 2½″. On the **31st** he rises at 6h. 36m. P.M., with a northern declination of 21° 50′. During the month he describes a short retrograde path in Taurus.

October is a fairly favourable month for showers of shooting stars, the most marked display being that of the Orionids on the **18th**, the radiant point being in R.A. 6h. 8m., and + 15°.

The Moon enters her first quarter at 5h. 32m. A.M. on the **3rd**; is full at 4h. 42m. P.M. on the **10th**; enters her last quarter at 9h. 9m. P.M. on the **18th**; and is new at 11h. 28m. P.M. on the **25th**. Several of the stars in the Pleiades will be occulted on the early morning of the **14th**.

Chess Column.

By C. D. Locock, B.A.Oxon.

Communications for this column should be addressed to C. D. Locock, Burwash, Sussex, and posted on or before the 10th of each month.

Solutions of September Problems.

No. 1.

(By W. Clugston.)

1. R to B3, and mates next move.

No. 2.

1. B to QB2, and mates next move.

Correct Solutions of both problems received from Alpha, Captain Forde, G. G. Beazley, W. Clugston, Col. Stewart, J. T. Blakemore, Jack, F. C. Thomson.

W. Clugston.—Thanks for the problems, which shall be examined.

H. H. Thomas.—Reading "QB" for "KKt" both your solutions would be correct; but the emendation is unnecessarily bold.

Alpha.—There is no dual. After 1. . . . P×P the KR is pinned.

Chess Editor, "Irish Figaro."—Many thanks for your columns.

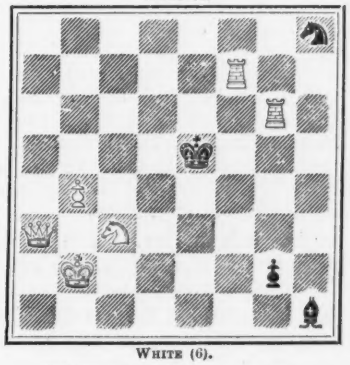
Dr. Hunt.—Thanks for your Tourney Award.

PROBLEMS.

No. 1.

By J. K. Macmeikan.

Black (4)



White (6).

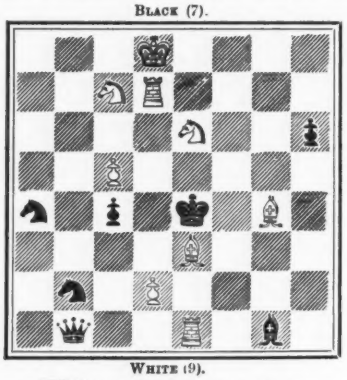
White mates in two moves.

No. 2.

By P. F. Blake, Manchester.

(First Prize Problem in *Bradford Observer* Tourney.)

Black (7).



White (9).

White mates in two moves.

CHESS INTELLIGENCE.

A match of not less than one hundred a side will be played at Brighton on October 6th, between teams representing East and West Sussex.

The following is the score of the Amateur Tournament held at Southampton last month :—

1.	H. E. Atkins (Leicester)	8½
2.	G. E. H. Bellingham (Dudley) ...	7½
3.	F. J. H. Elwell (Southampton) ...	6½
4.	W. H. Gunston (Cambridge)	6
5.	F. Hollins (Birmingham)	5½
6.	W. C. Palmer (Manchester) / C. H. Sherrard (Stourbridge) ...	5
7.	W. Ward (London)	4
8.	C. J. Lambert (Exeter)	3½
9.	E. Cresswell (London)	2½
10.	A. L. Stevenson (Ashford)	1

The scores of the leading players are in accordance with public form, Mr. Gunston having done better than on some recent occasions. Mr. Sherrard might have been a little higher, being Mr. Stevenson's only victim. Mr. Atkins retains his title of amateur champion and holder of the Newnes challenge cup, and that without losing a single game. In the Ladies' Tournament, out of a very small entry, Miss Finn was first and Miss Hooke second.

The list of competitors in the International Tournament now in progress at Berlin is as follows :—Messrs. Alapin, Albin, Von Bardeleben, Blackburne, Burn, Caro, Charousek, Cohn, Englisch, Janowski, Marco, Metger, Schiffers, Schlechter, Suchting, Tchigorin, Teichmann, Walbrodt, Winawer, and Zinkl. None of these can be considered weak players, but a tournament without Lasker, Pillsbury, Steinitz, and Tarrasch can hardly be considered at all representative of international chess. Some regret is expressed in English chess circles at the rejection of the entries of Messrs. Bird, Lee, and Mason. The former of these had recently lost his match with Mr. Lee by seven games to four, with three draws. Mr. Mason was, perhaps, regarded as a veteran out of practice.

Mr. Müller has defeated Mr. R. Loman, and has again won the championship of Holland, in a short match in which Mr. Loman did not win a single game.

The death is announced of Dr. van der Linde, the well-known author of the "History and Literature of Chess."

We have received the first number of the *American Chess Magazine*, a copiously illustrated periodical of sixty-four pages. Every department of the game appears to be adequately treated, and the publishers claim that succeeding issues will be even better than the first. The names of Messrs. Hodges, Hymes, Pillsbury, and Showalter are mentioned among those of future contributors to the magazine. The subscription is three dollars a year.

Game played in the City of London Club Summer Tournament :—

"Scotch Opening."

White. (T. Physick.)	Black. (H. W. Peachey.)
1. P to K4	1. P to K4
2. Kt to KB3	2. Kt to QB3
3. P to Q4	3. P × P
4. Kt × P	4. P to Q3
5. Kt × Kt	5. P × Kt
6. B to Q3	6. Kt to B3
7. Q to K2	7. B to K2
8. B to KB4	8. Castles
9. Castles	9. R to Ksq
10. P to KR3	10. R to Ktsq
11. Kt to Q2	11. R × P
12. Kt to Kt3	12. P to Q4
13. B to Bsq	13. R × Kt
14. RP × R	14. Kt × P
15. B × Kt	15. P × B
16. R × P	16. B to QB4
17. R to R8	17. Q to K2
18. B to K3	18. B to Q3
19. B to Q4	19. P to KR3
20. B × KtP	20. Q to Kt4
21. B × RP	21. Q to K4
22. P to Kt3	22. B × P
23. R × Rch	23. Q × R
24. Q to R5	24. Resigns.

KNOWLEDGE, PUBLISHED MONTHLY.

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Two Plates.—1. Fairy Flies. 2. Nebula Herschel V 14 Cygni.

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